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PROPAGATION

OF

FOREST TREES

HAVING COMMERCIAL VALUE

AND

ADAPTED TO PENNSYLVANIA.

By GEORGE H. WIRT, *Forester.*

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Department of Forestry,
Harrisburg, Pa., February 2, 1902.

The frequent demands made upon this office for information as to the best methods of propagating forest trees induced me to request Mr. Wirt, our State Forester, to prepare this bulletin upon the subject. I believe it will be timely and useful.

J. T. ROTHROCK,
Commissioner of Forestry.

Cont

8 Dec. 19 direct

LETTER OF TRANSMITTAL.

To Hon. J. T. Rothrock, Commissioner of Forestry:

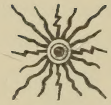
Dear Sir: I have the honor to submit herewith the following notes on the "Propagation of Forest Trees Adapted to Pennsylvania."

Recognizing the needs of our farmers, I have endeavored to present in a brief and clear way such facts and methods as will bring reasonable success to the inexperienced planter, without making necessary any large expenditure of money. The nurseryman or the forester may find nothing new and may even take exception to many statements.

The botanical names of the trees and their order, for the greater part, is in accordance with Gray's "Manual of Botany," sixth edition. In addition I have added those given by Britton and Brown in their "Flora of North America and Canada," when differing from the nomenclature of Gray.

Very respectfully,
GEORGE H. WIRT,
Forester.

Harrisburg, Pa., February 1, 1902.



THE FOREST NURSERY.

Forestry work does not consist entirely of raising trees from seed and of planting them, although that is a very important part of it. Nor is all planting of trees forestry work. Forestry is a business and must be conducted on a financial basis. Planting individual trees is done mostly from an aesthetic standpoint and at a comparatively high expense. Planting for forestry purposes, under existing conditions, must be reduced to the least possible cost, but it must be understood that more may be lost in this operation from lack of care and attention to the young plants than by trying to save time and money along some other line of work. The methods of raising trees are as varied and as numerous as the trees themselves, the people who plant them and the localities in which they are planted. In other words, the conditions under which each planter has to work are so different that there can be no exact method laid down that will be applicable for all trees and all places. But there are certain laws of plant life in general, and facts in regard to particular trees that, being reinforced by observation of nature and by common sense, will undoubtedly lead to a measurable degree of success. For what follows there is no claim of originality. It is merely a sifted collection of notes taken from the most reliable sources at hand and from the observation of successful nursery work.

Nursery.

Location.—If many plants are to be raised and the planting is to extend over a number of years, a permanent nursery must be prepared. Its proximity to the house of the person in charge will afford the advantage of easy and quick accessibility. Time can be saved in going to and from it. A frequent inspection of its condition and requirements is more likely to occur, and work may be done at odd times. On the other hand, if the planting is to be done within one or two years the nursery might best be placed near the prospective plantation in order to save time in removing the young plants, and to decrease the danger of loss resulting from exposure of the roots to sun and wind. Less preparation is needed, perhaps, in this case, and less care, in some respects, but in either case the following hints are applicable.

Aspect.—The land should have a very gradual slope, and face towards the northeast to give the best results. Good drainage will be obtained; the direct rays of the sun during the growing season are avoided and in spring there is more gradual thaw, a condition that is very desirable, for it is the sudden changes that affect plants most. Other slopes may be used of course, but protection from wind and from the sun must be provided for. As watering will often be necessary, a stream or a spring should be close at hand.

Soil.—The soil should be, preferably, a sandy loam of moderate moisture—neither too wet nor too dry. Heavy soil should be avoided. Whatever land is used, ought to be worked up thoroughly, to a depth of at least 1½ feet, in the fall and again in the spring. More especially should this be done on new land or on land that has not been worked for a long time. The top soil should be well and evenly fertilized. The more thoroughly the working is done the more oxygen for plant life there will be in the soil. The moisture will be better maintained. If the fertilizing is properly done, instead of raising seedlings with long, straggling roots, which cause more or less difficulty in transplanting, there will be produced strong plants with a compact system of root fibres, which is a better result for many reasons.

Beds.—The size of the nursery must be left entirely to the planter himself, but it may be a safe estimate to allow sixteen square feet of bed for every three hundred broad-leaved seedlings and for every six hundred conifers expected from a medium thickness of broadcast sowing.

If transplanting is to be done, fifteen to thirty square feet may be allowed for every one hundred conifers and thirty to sixty square feet for every one hundred broad-leaved seedlings. To prepare the beds stake out the paths or walks at right angles to each other. Shovel about six inches of soil from these and throw it on top of what will be the beds. These may be kept in better shape, then, if boards are placed around the sides, otherwise after each rain more or less soil is washed into the walks, often exposing the roots, or washing out entirely the plants along the edges. Long beds should be about four feet across so as to be worked easily from each side. Of course these are a saving in ground-space, but if there is much danger of damage from mice it is best to have small beds about five feet square. Or a ditch with perpendicular walls around the entire nursery will make it mouse-proof. For taprooted species of trees, such as oak, walnut, hickory, ash, etc., special beds might be made, so as to prevent the forming of long taproots, by placing on about a level with the walks a layer of boards or a very close layer of stones under the beds.

Moisture.—Moisture is one of the most necessary conditions of plant life, consequently the needs of the nursery in this direction must be carefully attended to. Frequent working of the soil and weeding will make a fine, loose cover for the beds, preventing evaporation to a very great degree. If the soil becomes too dry, watering must be done. Very good results are obtained if the water is allowed to flow through the walks, and to reach the soil in the beds by capillarity. Another good method is to make small irrigation trenches on the beds, fill them and allow the water to soak into the ground. Sprinkling is likely to form a crust which will increase evaporation. After a rain the beds may be too moist. If so, proper conditions can be made by sprinkling some dry sand over the ground. Young seedlings are very likely, too, to have earth spattered over their stems. Especially is this so with conifers and they should be freed of this as soon as possible by running a stick gently over them.

Weeding.—The nursery beds should be kept clean of weeds at all times. If the seedlings have been planted in rows, or in the case of transplants, weeds may be kept out by small billets of wood or by a layer of moss, or of leaves placed between the rows. Weeding should not be done after the first of September at the latest.

Shade.—During the first season's growth, the young plants will be very sensitive and they should be given some protection from the sun. This can be done by making lath frames which will let through about half the sunlight, and by placing them from two to six feet above the beds. Or a frame may be made on which branches can be laid. Some prefer simply sticking conifer branches into the beds in such a way that they form a slight cover. Lath frames are, perhaps, the most convenient, for the shade ought to be removed on cloudy days and during gentle showers. These covers, as well as the billets to keep down weeds, will help to preserve the moisture in the beds.

Seeds.

Choice of Species.—In determining the species to be raised, it is well to observe what trees are growing in the locality, not only within wooded districts but also along fences and in fields. They will give an idea of the quality of the soil and of what may be expected in the future, although this is not always the case, for other better species may have been forced out by some cause. Find out when these trees will have a good crop of seeds and then have everything ready for work when it comes. Not all trees bear seeds every year, as in the case of some oaks and conifers the period varies from two to five years, or even longer. Nor do all seed years produce a full crop of good seeds, as in the case of the tulip-tree. Then some seeds ripen in early summer, however, those of most trees do not ripen till fall, or even winter. From among these trees in the neighborhood, if they are the proper species, select the healthiest ones and gather their seeds as soon as ripe.

Time of Sowing.—Seeds of the poplars, soft maple, white elm, paper and river birch, and others maturing in summer should be sown at once. They lose their power of germination in a short time. Seeds of oaks, hickories, walnuts, conifers, and others which mature in fall may be sown at once. The freezing and thawing of winter will be beneficial to them, but the destruction by squirrels, mice, and birds that is likely to occur is sufficient reason for not planting until spring, if the seeds can be preserved properly. They should not be allowed to dry out before planting nor should they be exposed constantly to much moisture if they are to be kept for any length of time.

Thickness of Sowing.—By making tests, either by cutting seeds or by placing them between wet flannels in a warm room, so as to produce germination, or by some other method, the percentage of good seed is determined and from this the thickness of the sowing. It is very easy to sow too thick, and then the seedlings will be weak, but it is cheaper to thin out, and perhaps set the young plants in other ground, than to have to fill up blanks.

Depth of Sowing.—The difficulty, in too many cases, has been that instead of the seeds being planted, they are buried. As a general rule, for depth of cover, the diameter of the seed is sufficient, but if the ground is left very loose, or if there is danger from frost late in spring, a heavier covering should be given. It is well, after sowing, to roll the beds or to press the ground with a spade or a board. In fall sowing cover the beds with a layer of leaves. It will prevent the ground from heaving during the time of frost and in the spring will prevent the heavy rains from washing out the seeds. This may be done to advantage, too, after spring sowing. In both cases a careful watch must be kept and as soon as the seedlings appear the leaves should be raked off. Branches might then be spread thinly over them to keep the birds away, but these should not be left on too long so as to in any way interfere with the growth. Small seeds may be coated with red lead as a protection against birds.

Manner of Sowing.—As a usual thing the smaller seeds are sown, broadcast in the nursery, especially those of the conifers, the ash, the birch, etc. The larger seeds, as those of the oaks, hickories, walnuts, etc., are usually sown in furrows, or rows, from six to twelve inches apart, on the nursery beds. The latter are often sown in rows where the plants will remain permanently. This may be advisable with with taprooted species. Broadcast sowing over a plantation is very expensive and is very seldom done.

Transplanting.

Age of Plants.—Most plants after they have remained in the seed beds for one season, may be set out where they are to stand finally, especially broad-leaved ones. The spruces and firs grow very slowly during the first four or five years and may best be left two years in the seed bed, then transplanted to other nursery beds and allowed to remain there two or three years. Small and weak seedlings of other species should be treated in the same way. Frequent transplanting is recommended for all species, when especially large and strong plants are needed. In all cases before setting out finally, whether on good or poor land, the object should be to grow and to use only the strongest and best plants. They will be able to resist enemies and hardships and to recover from injuries much better than weak ones.

Time.—Transplanting can be done either in fall or in spring. If done in fall, it should be after the growth has ripened or ceased. During winter the dirt will have a chance to settle about the roots, and by spring the loss of root fibre will be partly made up. On the other hand, frost may lift the plants out of the ground or storms may loosen them. Then, too, they will be exposed to damage from animals at a time when food is scarce. In spring the work should be done as early as possible, at least before the new growth begins. Spring is preferable for conifers.

Distance.—The distance at which plants should be placed finally depends upon the species, the age and the object in view. If firewood is the only object then perhaps more wood will be formed per tree by giving as much room and light as possible to the tops. Even in this case it is a question whether close planting is not better financially, if small wood can be used or sold at all. Where it is the purpose to get the soil covered quickly, to raise straight stems clean from branches, either for poles or posts, or later for timber, close planting must be done. For plantations of considerable size, to plant at regular distances and to do it in a systematic way is at all times cheapest. Cultivation may be done more quickly and easily. Blanks may be easily found and filled, and later management is facilitated. Of course mere filling of gaps in existing forests can be done only in a very irregular method.

Roots.—There are numerous methods of planting, but, in all, the most important thing is to take care of the roots. Perhaps more failures could be traced to lack of care of them than to any other cause. They are very sensitive to sun and wind and should never be exposed long enough to become dried out. When the plants are removed from the nursery they should be taken from the beds as carefully as possible so that very few roots be broken. Wrap the roots in wet burlap or cover them with moist moss, or place them in thin mud. The plants may then be carried safely to the place of planting. If it is not done at once they should be "heeled in." In planting do not cramp the roots in any way and see that the growing ends are down, and not up. Place fine soil among the roots and pack it thoroughly. If sod has been taken out, turn it upside down on the ground close to the tree. Young plants are sensitive to being planted too deep and so should be no deeper than they were in the nursery. Of course with larger plants, when a great deal of dirt has been loosened, allowance must be made for some settling, but this will not be necessary if packing is well done. When larger roots have been broken or bruised they should be cut off smooth with a sharp knife. Planting can not be done too carefully.

Methods.—In loose and in sandy soil small plants may be set out quickly with the "dibble." This is simply a wooden peg or some iron instrument which will make a hole large enough to have the roots dropped into it. The hole should be made deeper than the roots are long. Place the plant in the hole as far as convenient and then raise it to the proper planting depth. In this way the roots will be in a natural position and not turned up, or to one side. The hole is closed by running the dibble into the ground near the hole and forcing the soil against the roots. This method may be used to good advantage within a forest to fill up blanks if the soil is deep enough.

The most common method, and that applicable under more conditions than any other, is planting in holes that have had to be dug in some manner, as with a spade or hoe. It is necessary for large plants. It is the best method for small plants in heavy soils and in stony places. In fact it may be used anywhere but in the very wet soils. It is well to have the holes dug in fall and allowed to lie open during the winter for spring planting. Humus, rich ground or manure may be used in planting, and if so, should be well placed among the roots, the poorer soil being placed on top. Each plant should be made firm.

On hillsides where a plow can be used terraces may be formed by laying rows of stones along the hill side, or if more time can be taken, by putting in stakes and placing small branches on the uphill side. Run a furrow above this in autumn and during winter the ground will be more or less broken up, facilitating spring planting a great deal. Where a plow can not be used on a slope the only resource is to dig holes just wherever possible and put in strong plants.

In wet soils, swamps or marshes, mound planting may best be used. This is very similar to hole planting, except that the plant is put into the ground thrown out of the hole instead of placing it in the hole itself as in the other cases. If sod has been lifted, split it and place the plant in the crevice. Here, too, the ground must be thoroughly packed around the roots of the plant. When balls of dirt are taken out with the plants, holes must be dug somewhat larger than the size of the ball on the plant. When this is done the plants may be moved at any time of year and to any place. If the plants are crooked or branchy after planting, cut them off about an inch and a half above ground.

A few trees, such as willows and poplars, may be propagated by cuttings. It is recommended that the cuttings be gathered in fall from last year's shoots and buried during winter. They should be planted in spring while the ground is still moist. They will do well if not gathered till spring, but before the new growth begins, and planted at once. When planting leave one good bud above ground. The others may be rubbed off. Layers or root suckers may be used in a few instances but as a general rule, willows and poplars being an exception, it is better to raise trees from seed.

CUCUMBER TREE, MOUNTAIN MAGNOLIA.

Magnolia acuminata, L.

This tree is nowhere common in Pennsylvania. It is, however, a tree that is worthy of being cultivated because of the peculiar fitness of its wood for pump stocks, watering troughs, etc.

The fruit is a cylindrical mass resembling the cucumber, whence the tree's name. This becomes red in autumn and it is then time to watch for seeds, in order that they may be gathered as soon as ripe. About the last of September, or the first of October, when fully mature, scarlet seeds may be seen suspended from the fruit by delicate white threads. Owing to an oil in the pulp that encloses each seed they become rancid and lose their power of germination as soon as the pulp decays. They should be placed at once in water of 70 degrees to 80 degrees Fahrenheit and macerated for about a week, when the seeds can be thoroughly washed. These should then be fixed in a box in alternate layers of sand and seeds, and kept in a cellar where they will not freeze. As soon as the ground is warm in spring, about the middle of May, they may be sown in furrows from six to eight inches apart, on well prepared seed beds and covered lightly. If any fertilizing is done a small quantity of wood ashes or of bone dust is best. It is said that manure should not be used. The seedlings, after remaining in the seed beds for two years, should be ready for being set out where they are to remain. If intended for lawn planting they may be transplanted every two or three years until wanted.

The tree is found naturally in valleys or coves of mountainous regions, and along rocky streams, prefering deep, rich soil. To do well they must be planted in conditions as near as possible to those under which they do best naturally. Plant in rows from two to five feet apart and from eighteen to twenty-four inches in the row. Close planting will prevent early branching.

SWEET BAY, SWAMP SASSAFRAS, BEAVER TREE.

Magnolia glauca, L.

Magnolia Virginiana, L. See Britton & Brown, Vol. II, p. 48.

The tree never reaches a very great size in this State and is of very little importance except as an ornamental tree. Its flowers appearing in June and continuing for several weeks are very beautiful and fragrant. It prefers moist or swampy soils in a sheltered position. Propagation from seed is the same as that for the cucumber tree, but it may be easily propagated from layers which, it is said, require two years to root. It is frequently grafted upon a root of the cucumber tree and seems to grow better there than on its own roots.

UMBRELLA TREE, ELK WOOD.

Magnolia Umbrella, Lam.

Magnolia tripetala, L. See Britton & Brown, Vol. II, p. 48.

Very seldom found in Pennsylvania, nor does it attain a great size here. Professor Sargent says that it is hardy in cultivation as far north as New England. The branches are very irregular, with leaves at the ends giving the appearance of an umbrella. Large white flowers appear about May, making a very attractive tree. Its propagation is similar to that of the cucumber tree.

TULIP-TREE, TULIP POPLAR, YELLOW POPLAR.

Liriodendron Tulipifera, L.

The tulip-tree is one of the most magnificent of the forest trees and its wood is valuable for many purposes. It is a fairly rapid grower and as it is becoming very scarce its propagation should be encouraged.

The fruit has a cone-like appearance, being made up of a number of scales, on a common axis, from which they fall during winter. Very few of these scales contain seeds and only about ten per cent. of the seeds formed are good. Loudon said that the best cones are found on the higher branches of aged trees. In autumn, as the seeds mature, the fruit turns to a brownish color. The cones should be gathered in October after the first few scales have dropped. Drying them in an ordinary living room for a short time ought to be sufficient to free the seeds from the scales. The seeds may be sown broadcast, or in shallow furrows, in fall, or they may be kept in a dry room until spring. Roll the beds after giving the seeds a slight cover. Soft mold or wood and leaf ashes are good fertilizers for them. In summer do not allow the beds to become too dry and give the young plants some protection from the sun. The plants may remain in the seed beds for two years, to develop a good root system before being planted permanently, or if they are wanted for ornamental purposes they may be transplanted and left two or more years. After transplanting first time it is better to cut the stem off a couple of inches above the ground, allowing a new stem to be formed.

Rich soil of coves and of cool slopes is its preference. It is known to come up in old fields after an advance growth of sassafras or locust, or with locust. Seedlings are plentiful in the forest near old trees after a winter or spring fire has burned the layer of leaves on the ground. It may be set out as the cucumber tree, with locust or with walnut, or with both. Trees are said to be raised easily from cuttings.

BASSWOOD, AMERICAN LINDEN, LIME TREE, LIN.

Tilia Americana, L.

The linden has a one-seeded fruit which when it is matured in September is hard, hairy, gray and about the size of a pea. They should be sown at once in the seed beds, or if kept over winter, should be stratified with moist sand in a box which can be placed in well drained ground. In either case a good percentage will come up the first year, but if they have been kept dry over winter they are likely to wait until the second year before germinating. They are very slow growers from the seed and will have to remain in the nursery for two, three, or four years, and perhaps more, before they will be large enough to set out permanently. They may be then planted with oak, sugar maple, white ash, etc. As with other trees, if the plants are crooked, or too branchy, cut them off just above the ground and allow a shoot to form. More rapid growth is obtained from layers, so it is customary to cut off an old tree close to the ground, and when a number of shoots have come up, to throw dirt among them that they may take root for themselves. In one or two years they may be cut off and used as plants. Transplanting with balls of dirt is recommended. It prefers a moist situation but will grow on dry soil. As a shade tree it is probably not surpassed.

WHITE BASSWOOD.

Tilia heterophylla, Vent.

The white basswood is more of a mountain tree than the Tilia Americana. It is commonly found growing on the moist soil bordering mountain streams, however, it will thrive upon limestone soil, or dry, gravelly and sandy soil, if moderately rich. The wood of this tree is not unlike that of the other species of basswood and is sold as such. It can be propagated the same as the basswood above, either from seed or from cuttings, the latter being, perhaps, preferable.

AMERICAN HOLLY.

Ilex opaca, Ait.

While the holly, under favorable conditions, becomes a tree of good size, and is then valuable, it is not likely that, in this State at least, it will ever be raised for other than ornamental purposes. The fruit is a small red berry, maturing in autumn and remaining on the tree all winter. The berries may be gathered in December and at once macerated in water. After the seeds have been thoroughly washed, they should be spread on a cloth and dried, and then mixed with sand and kept dry until needed for sowing in spring. Sow in furrows ten to twelve inches apart. Cover seeds lightly with fine earth and roll it. A layer of leaves may then cover the bed which will perhaps hasten germination. The seeds are slow to germinate and may not come up until the second year. The plants should be carefully transplanted every two years until set out finally. It seems to prefer the edge of streams or swamps, under other trees, but it will grow on higher ground. It makes a close hedge and requires little care when once started. It is also propagated by cuttings.

OHIO BUCKEYE, FETID BUCKEYE.

Aesculus glabra, Willd.

The wood of this tree is used for pulp wood and for the manufacture of light wooden articles. Although there are other rapid growers, the wood of which is better in quality and may take the place of the buckeye, yet the facility with which it can be raised from seed together with its rapid growth may recommend it.

The fruit resembles the common horse-chestnut but is prickly when young. It matures in autumn and the seeds may be gathered from under the old tree after the first frost. They should be planted at once, either where they are to remain, say two or three feet apart each way, or they may be planted in seed beds, in rows eighteen to twenty-four inches apart and twelve to fourteen inches in the row. Cover a little more than the thickness of the seed, unless the beds are rolled. In one year the plants may be set out. They prefer moist soil, as along the banks of rivers, but will do well in soil that it is not exceedingly dry.

SWEET BUCKEYE.

Aesculus flava, Ait.

Aesculus octandra, Marsh. See Britton & Brown, Vol. II, p. 401.

The tree has a smooth fruit, has the same uses as the Ohio buckeye and may be propagated in the same manner. Either may be used as a shade tree, although the European horse-chestnut is superior and more frequently used for that purpose.

SUGAR MAPLE.

Acer saccharinum, Wang.

Acer Saccharum, Marsh. See Britton & Brown, Vol. II, p. 398.

In the Forestry Report for this State issued in 1895, it is stated that this is one of the largest and perhaps one of the commonest trees in the State. It is apparent therefore that conditions here are favorable to its growth. It is a valuable tree and will grow in almost any locality.

The seeds, in samaras or keys about an inch long, are matured in September. They may be picked from the tree, or a little later swept together under the tree, as they are usually very plentiful. They are very sensitive to being dried out and therefore should be sown at once. The rows should be about eight inches apart and the seeds six inches apart in the rows. A very light cover of earth is sufficient, but put a layer of leaves over the beds for the winter. The seeds may be kept over winter if stratified with sand just slightly moistened, then sown early in spring. During the first season the young plants will need shade. They may remain in the seed beds two years and then be set out permanently at three, four or five foot distances. Prune off any branches that may have formed. The sugar maple has been planted in pure plantations and also in mixture with white ash, walnut, oak, birch and others. It is among the best of the trees suitable for street planting.

What is known as black sugar maple is a variety of Acer saccharinum and is propagated in the same manner.

The striped maple (Acer Pennsylvanicum, L.), so called from the striped appearance of its bark, is of little importance except as an ornamental tree. Its seeds ripen in September and may be raised as the above. It is found in cool ravines and endures considerable shade.

SILVER MAPLE, WHITE OR SOFT MAPLE.

Acer dasycarpum, Ehrh.

Acer saccharinum, L. See Britton & Brown, Vol. II, p. 397.

This is perhaps the most rapid grower among the maples, and it is adapted to any soil, but it is of very little value. The keys are large, veiny and diverging. The seeds ripen early in summer, in May or June. They may be swept up under the trees and should be sown at once. If planted in moist beds and given a light cover of earth it will not be long before the young plants put in an appearance. Sow the seeds in rows about twelve inches apart and in distances of eight inches in the row. If started in good soil one year will be sufficient time in the nursery, but if in poor soil they will take two years to grow to a size suitable for planting. These plants are apt to branch young, so when planting, if they are branchy or crooked, cut them off just above the ground. The sprout that will be formed will make up for the growth that has been lost.

RED MAPLE, SWAMP MAPLE.

Acer rubrum, L.

The red maple is a more valuable tree than the soft maple and as it thrives in swamps (although not confined to them) which are rarely of any use, there is no reason why it should not be raised. The seeds ripen in May or June and perhaps can best be picked from the tree. They should be planted at once in moist soil, as with the soft maple. The first year they grow slowly and may have to remain in the seed bed two years. Pruning with these, too, may be necessary. Where the soil is good it makes a beautiful shade tree.

BOX ELDER, ASH-LEAVED MAPLE.

Negundo aceroides, Moench.

Acer Negundo, L. See Britton & Brown, Vol. II, p. 400.

In wooded sections of the country this tree is of little value, but in the plains it serves as a splendid "nurse tree" to other more useful species. It is a rapid grower and will thrive on any soil, hence, where a quick protection to the soil, or a quick shade is wanted, there is nothing better; for instance, for the protection of white pine seedlings on a dry southern slope. It is short lived and when planted with other trees affords an early return in the way of fire wood. The seeds are ripe in September and should be sown at once. In one year the seedlings can be planted out. With conifers, box elder may be planted in every other row at four foot distances, the rows being three feet apart. With broad-leaved species every third row would be sufficient.

STAGHORN SUMACH.

Rhus typhina, L.

Rhus hirta, (L.) Sudw. See Britton & Brown, Vol. II, p. 386.

Mostly a shrub but at times reaches the dimensions of a small tree. The wood has a beautiful grain and will take a polish, making it suitable for panels, etc. The fruit (small, hard, strong seeds) is compacted into an irregular, brown or scarlet mass. The seeds mature about October, after which they may be gathered and sown at once, or kept in a dry, cold place until spring. The sumach is found in thickets, both on the borders of streams and on dry hill sides; it seems to grow more rapidly, however, on the moist soil and usually produces there a stem more or less free of branches.

LOCUST TREE, BLACK LOCUST, YELLOW LOCUST.

Robinia Pseudacacia, L.

The locust has many qualities that recommend it to the tree planter. The foliage and blossoms make it suitable for a shade tree, especially along country roads. It is a rapid grower and can be reproduced easily from seeds or from root suckers. It will grow on any soil that is not wet, and, like all leguminous plants, it improves the soil on which it grows. Moreover the wood is strong and of great durability. Yellow locust wood is supposed to be more valuable than white locust wood, but both come from this species.

The fruit, a pod enclosing several seeds, is matured in September and may be gathered from the tree any time after that, for frequently they remain on the tree all winter. The seeds may be threshed out with a flail and cleansed by running them through a winnowing machine. Field mice are fond of them, consequently it is best to keep them for spring planting, which is easily done if they are kept in a cool, dry atmosphere. Before planting, put them into scalding water and remove them as soon as they swell up. Repeat the operation until all are ready, then plant at once in the seed bed, about six inches apart each way. The young plants may remain in the beds one or two years when they may be set out permanently at four foot distances. At first sight of the borer's work cut off the branch or the whole stem and burn it. If branchy when transplanted pruning will be necessary. It may be planted by itself or mixed with other species, as yellow poplar, catalpa, walnut, etc.

JUDAS TREE, RED BUD.

Cercis Canadensis, L.

Hardly more than a shrub. Its wood is seldom if ever used. In spring the bush is aflame with red flowers, making it worthy of a place on the lawn. The fruit is a legume, or pod, ripening in autumn.

These may be gathered and kept until spring, the seeds to be sown early. It does not seem to be particular as to soil and may be planted under other trees or shrubs. In growth it is fairly rapid.

KENTUCKY COFFEE TREE, COFFEE NUT.

Gymnocladus Canadensis, Lam.

Gymnocladus dioica, (L.) Koch. See Britton & Brown, Vol. II, p. 261.

Very similar to the locust in qualities and requirements. Like all other broad-leaved species it reaches its best development on moist, rich soil. The seeds mature in October and may be taken from the pods readily after a severe frost, or the pods may be gathered and macerated in warm water. Dry the seeds and treat as locust seeds. The growth is rapid, so close sowing is not necessary, neither is the tree so apt to branch as the locust.

HONEY-LOCUST.

Gleditschia triacanthos, L.

This tree as yet has very little value other than as an ornamental tree. It requires rich soil. The pods may be gathered in September or October and macerated in water until the seeds can be washed clean. They can be treated then as those of the locust and coffee tree. The taproot should be cut off before transplanting.

WILD CHERRY, WILD BLACK CHERRY.

Prunus serotina, Ehrh.

A neglected but valuable tree. It is a fairly rapid grower, not particular in regard to soil, and furnishes a fine wood for the manufacture of furniture. The fruit is matured in August. It can then be gathered from the tree and macerated in water until the stones can be cleaned. These may be sown at once, but it is well to preserve them until spring by mixing them with sand and placing the box either in a dry, cool cellar or in the ground where the stones can be frozen. They must not be allowed to become moist. Sow in furrows six to eight inches apart and two or three inches in a furrow. They will be of sufficient size in two years to be moved safely. They may then be mixed with seedlings of ash, elm, oak, pine, spruce, etc., at four foot distances.

Prunus Pennsylvaniaca, L. fil., or the fire cherry, is of little value other than as a nurse tree to better and weaker species. It may be used as the box elder. Propagation is the same as for the black cherry. The fruit is ripe in July.

AMERICAN CRAB-APPLE.

Pyrus coronaria, L.

Malus coronaria, (L.) Mill. See Britton & Brown, Vol. II, p. 235.

The tree never reaches a very great size and its wood is of little value except for tool handles or turnery work. As an ornamental tree, however, it is worth some consideration. Its flowers are numerous, fragrant and of delicate tints. The fruit matures late in fall, when it may be gathered and macerated in water in order to obtain the seeds. Several years in the nursery may be required before the seedlings will be large enough to be planted out with safety. Pruning may be necessary in order to avoid a straggling form. It is usually found in rather moist soil.

MOUNTAIN ASH.

Pyrus Americana, DC.

Sorbus Americanus, Marsh. See Britton & Brown, Vol. II, p. 233.

Of no value other than as an ornamental tree. It grows both on highlands and on lowlands. The berry-like fruit grows in clusters and matures about October. The seeds may be obtained by maceration, and after being dried on a cloth should be kept in a dry, cool place for spring planting. Frequent transplanting before setting out permanently will no doubt secure the best results for ornamental use.

COCKSPUR THORN.

Crataegus Crus-galli, L.

Except for hedges the cockspur thorn is little used. It is occasionally found as a lawn tree because of its white flowers, which appear in June. The fruit matures in October. The seeds may be obtained by maceration and can be sown at once or kept for spring sowing.

JUNE BERRY, SHAD BUSH, SERVICE BERRY.

Amelanchier Canadensis, T. & G.

Another tree, more often a shrub, which is more ornamental than useful. It is among the first of our trees to bloom in spring and is very attractive because of its many white flowers. The fruit matures in June or July and is then edible. The seeds are obtained by maceration and should be sown at once. It has been found on soil varying from dry "barrens" to the wet borders of swamps.

GUM, SWEET-GUM, BILSTED.

Liquidambar Styraciflua, L.

A tree that grows to large size and furnishes a fine grained lumber suitable for veneer and interior finishing. The fruit, a ball with rough projections, matures in autumn, when the seeds drop out. They may be gathered in September or October and sown at once in the seed beds, either scattered thinly broadcast, or in furrows four to six inches apart. Give them a light cover of soil and as with other seeds sown in fall, spread leaves over the beds to protect them during the winter. Two years may be required to allow the seedlings to become of sufficient size to transplant. They may be set in almost any soil, but because of their tendency to branch set the plants not more than three feet apart each way. It presents a beautiful appearance in autumn and is suitable for a lawn tree.

DOGWOOD, FLOWERING DOGWOOD, BOXWOOD.

Cornus florida, L.

As the name implies the tree is conspicuous for its flowers. Its autumn colors are just as attractive, hence as an ornamental tree it is well worth consideration. In order to secure a straight trunk, and a regular shape, plant the young tree, then when it has a year to "root itself" fairly, cut the stem off (in spring or early summer) close to the ground. It will then produce several shoots. Select the one you prefer and remove the rest. As this retained shoot grows and makes its branches, keep cutting off the lower ones until the stem is as high as you desire, after which it may be trusted to care for itself. It rarely attains great size but the wood is valuable for tool handles, mallets, etc., where it will undergo hard usage. As a forest tree it is scarcely better than a weed, permitting no other species to get a start beneath its shade. The fruit is a small, red berry maturing in September. The berries may be picked from the tree and macerated until the pulp can be removed from the seeds. Mix these with damp sand and place in well drained ground over winter. Plant early in spring. During summer protect from the hot sun. After two years the plants may be set out, either in the open or under the shade of other trees.

The alternate-leaved dogwood, having a "blue-black" berry, is of little value even as an ornamental tree.

TUPELO, PEPPERIDGE, BLACK OR SOUR GUM.

Nyssa sylvatica, Marsh.

Black gum, in favored localities, often grows to a large size. It prefers damp, rich soils but will grow in dry situations. It may be used for landscape work. The wood is hard to split and is used where such characteristic is needed. The fruit ripens in September and may be picked from the tree. Macerate in warm water until the seed or stone is clean. Mix with damp sand and place in ground well protected from moisture. In spring sow about two inches apart in rows. Keep the beds moist. In two years the plants may be moved and should be set two to three feet apart. They are, otherwise, likely to branch.

LAUREL, MOUNTAIN LAUREL, CALICO-BUSH.

• Kalmia latifolia, L.

RHODODENDRON, ROSE-BAY, GREAT LAUREL.

Rhododendron maximun, L.

These two shrubs are of little value other than for ornamental use. They are comparatively easy to transplant from the woods. The young plants should be taken up in early spring with considerable dirt to the roots. After transplanting pack a thick layer of leaves about the foot of the shrub and keep them moist until a good growth is evident. Propagation from seed is said to be difficult and expensive. For planting in open grounds it is best to secure specimens which have grown in open grounds.

PERSIMMON.

Diospyros Virginiana, L.

This tree is more valuable for its fruit than for any other purpose. The heartwood, which takes almost a century to form, is very dark. The wood's "capacity for enduring friction is phenomenal." The fruit is mature in autumn and may be picked from the ground under the trees after several frosts. Remove the pulp from the seeds, mix them with moist sand and preserve in a cool cellar. Sow in rows in spring and, as with all slow growing species especially, cultivate well. In two years they may be removed from the seed bed. It grows on light, sandy soil or in bottom land. Occasionally it is found growing on high dry ground. In parts of the United States persimmon culture has become quite common and several improved varieties of the fruit are already produced.

WHITE ASH.

Fraxinus Americana, L.

A magnificent and valuable forest tree. Its wood is extensively used in the manufacture of furniture, wagons, farming implements and oars. It does not seem to be particular as to location, but if the wood of the more rapid growing trees is best, then moderately rich soil where the roots can get plenty of moisture is preferred, as along streams. The fruit is winged and matures in August or September. It should be sown broadcast at once in well raked beds. During the first summer provide shade for it and, if necessary, moisture. The seedlings may be removed when one year old. If the taproot has not been retarded it is better to cut it off than to run the risk of turning the growing end up when planting. It may be mixed with walnut, oak, maple, hickory, etc., at three or four foot distances.

The green ash and red ash are somewhat inferior to the white ash in respect to their timber qualities. If cultivated at all, they may be propagated in the same manner as the white ash.

BLACK ASH, HOOP ASH.

Fraxinus sambucifolia, Lam.

Fraxinus nigra, Marsh. See Britton & Brown, Vol. II, p. 602.

The black ash, growing in wet and swampy soils, although capable of growing on dry soils, is used very much for hoops, basket weaving and interior finishing. Its seeds ripen several weeks later than those of the white ash but are treated in a like manner.

CATALPA, BEAN TREE, INDIAN BEAN, CIGAR TREE.

Catalpa bignonioides, Walt.

Catalpa Catalpa, (L.) Karst. See Britton & Brown, Vol. II, p. 199.

A tree to which a great deal of attention has been called of late. It is a rapid grower on almost any soil, producing, in a very short time, stems large enough for railroad ties or even telegraph or telephone poles. The fruit is a pod enclosing numerous small winged seeds. These pods remain on the trees during winter and may be gathered any time after October. Remove the seeds and keep in a cool, dry atmosphere until the ground can be worked in spring. Sow the seeds broadcast and cover with fine dirt. By the next spring the seedlings can be set out in rows. If by themselves, three or four foot squares will make proper distances for planting. They may be planted with locust, maple, ash, pine, etc. It has been recommended to plant them in alternate rows with field corn. This will afford some cultivation after the plants have been set out. White pine might then be set along the corn rows after one or two crops have been removed. If any damage comes to the young plant, cut it off at the ground, for as long as the root is healthy a sprout will soon come up which will probably produce a better tree than the seedling stems. This indeed, is the best way to secure a trunk long enough and straight enough for a telegraph pole. Cuttings may be used for propagation. The wood, whilst it resists decay in the ground, appears to lack strength sufficient for a good railroad tie.

WESTERN CATALPA.

Catalpa speciosa, Warder.

It is said that the wood of this species is more durable in contact with the ground than that of the Catalpa above mentioned. As a rule it produces straighter stems and is freer from branches. The growth is rapid in almost any soil, producing a good crop of telephone poles, etc., in twenty-five years, or less. It can be propagated as the above, either from seed, or from cuttings. Its value for railroad ties has been greatly overestimated.

SASSAFRAS.

Sassafras officinale, Nees.

Sassafras Sassafras, (L.) Karst. See Britton & Brown, Vol. II, p. 97.

Although a rapid grower, the tree will hardly be planted much in Pennsylvania because of its timber qualities. It is very frequently found in old fields, preparing the soil for a more valuable species and acting as a nurse to it. As such it may be used to advantage. The fruit matures in September. The pulp must be washed from the stone, which should be planted at once in rich, moist soil. Two years will not be too long for the seedlings to remain under nursery care. After they have had a start in the plantation, yellow poplar, sugar maple, white pine and perhaps hemlock might be mixed with it in alternate rows. It sprouts readily and may be raised from suckers or from bits of root.

SLIPPERY ELM, RED ELM, MOOSE ELM.

Ulmus fulva, Michx.

A tree which is suitable to plant in wet locations, although it is sometimes found on the hillsides. By some the wood is said to be superior to that of the white elm. The fruit is mature in June. It may be gathered from under the tree and sown at once in the nursery beds. If they are dry, moisture should be applied to the beds artificially. Give protection during summer from the sun. If the moisture has been sufficient, the plants may be set out that fall, but it may be best to allow them to remain for another year. Fall transplanting is preferred. It may be mixed with beech, oak, ash, or sugar maple.

WHITE ELM, WATER ELM, AMERICAN ELM.

Ulmus Americana, L.

The white elm rivals the sugar maple in size. Its wood is very hard to split and is used where such resistance is necessary. It, too prefers moist, rich soil, but will grow in other situations. The fruit is mature in June and should be treated as that of the slippery elm. It may be mixed with birch, beech or maple.

HACKBERRY, SUGAR BERRY.

Celtis occidentalis, L.

Although this tree reaches a fair size, its wood is of no practical importance. The fruit is a small drupe, maturing in autumn. The seeds may be obtained by maceration and should be sown in moderately moist beds at once. Two years are often required for the seeds to germinate. The young seedlings should have some protection from the sun for several seasons and their roots kept moist. They may be propagated by cuttings.

OSAGE ORANGE, BOW WOOD, BOIS d' ARC.

Maclura aurantiaca, Nutt.

Toxylon pomiferum, Raf. See Britton & Brown, Vol. I, p. 529.

Another valuable but neglected tree. It is a rapid grower and not particular in choice of soil. Its wood has been found to be very valuable in the manufacture of wagon wheels, and has also been used with good success as railroad ties. The fruit matures in October but as it is frequently seedless, and as the tree is readily propagated from cuttings, it may be cheapest to use the latter method. If seeds are obtained after macerating the fruit, they should be kept in a cool, dry atmosphere and sown in spring. The tree is frequently used for hedges, when it needs considerable pruning. In plantations it should be planted closely. It is not a native of Pennsylvania, but is introduced from the southwest.

RED MULBERRY.

Morus rubra, L.

The fruit, resembling an elongated blackberry, is mature in July. It should be picked from the tree and macerated in water, the seeds cleaned and then kept in a cool, dry atmosphere until spring. Sow thinly over the beds and cover with fine dirt. Keep the beds moist and protect the young plants from the sun. After two seasons growth they can safely be placed in the plantation. They endure some shade so may be set among other trees. It prefers low, rich soils.

BUTTONWOOD, SYCAMORE.

Platanus occidentalis, L.

A rapid grower, often reaching a very large size, and not particular as to location. The wood, however, is of very little value, except in the manufacture of tobacco boxes. The common "button balls" are made up of a number of seeds which mature about October. Sow them as soon as ripe, and cover lightly, or keep them dry over winter and plant early in spring. The seedlings may be planted when one year old.

BLACK WALNUT.

Juglans nigra, L.

A tree valuable both for its wood and its fruit. That it is almost exterminated in Pennsylvania is well known and yet it is a fairly rapid grower and readily propagated from seed. The nuts mature in fall and after a slight frost may be picked up from under the old trees in quantities. Where there is no serious danger from mice and squirrels the nuts may be planted at once (after slightly bruising the hull) in rows about a foot apart, and from four to six inches apart in the row, for they branch early. To prevent the taproot from becoming too long a close layer of stone may be laid before the nursery beds are formed, or the plants may be started in boxes about six inches deep, having holes in the bottom and sides to allow proper drainage. Transplant when one year old. To keep the nuts over winter, remove the "hull" and mix them with moist sand and bury in the ground. Plant as soon as taken up in the spring. If desired, the nuts can be planted at once where the tree is intended to remain. Locust, maple, beech, or catalpa could be mixed with it in the plantation. It might be raised with field corn.

The white walnut or butternut, having an oblong, pointed nut, may be raised in the same manner. It will grow on both high and low ground, whereas the black walnut rarely does well in a dry situation.

SHELL-BARK, SHAG-BARK HICKORY.

Carya alba, Nutt.

Hicoria ovata, (Mill.) Britton. See Britton & Brown, Vol. I, p. 485.

There are said to be nine species of hickory on the continent, but there are only three that are of any importance to us. The shag-bark, so called from the appearance of its bark, prefers rich, damp soil and in such is a rapid grower. The fruit matures in October and may then be gathered from under the trees. They should be placed in moist sand and kept for spring planting. Because of the taproot it may be best to plant at once permanently, and if possible raise some field crop with the young plants. Make furrows about three feet apart and drop the nuts about every half-foot. Weeds will have to be kept down. If raised in a nursery, care will have to be taken in transplanting, because of the long taproot. Cut off any bruised or broken roots.

WHITE-HEART HICKORY, HICKORY, KING NUT, MOCKER NUT.

Carya tomentosa, Nutt.

Hicoria alba, (L.) Britton. See Britton & Brown, Vol. I, p. 486.

The young shoots of this tree are hairy; the nut angular and pointed. It may be found more frequently and is perhaps the best of the family from the standpoint of forestry because of its choosing the poorer soils, although its slow growth is against it. It is raised as the shag-bark hickory.

PIG NUT, BROOM HICKORY, SWITCH BUD HICKORY.

Carya porcina, Nutt.

Hicoria glabra, (Mill.) Britton. See Britton & Brown, Vol. I, p. 487.

The bark is furrowed on older trees; the fruit is thin shelled. The wood rivals that of the shag-bark, said by some even to surpass it. It will grow both in high and low situations, but in Pennsylvania at least it prefers moist soil. It is also treated as the shag-bark hickory.

BIRCHES.

Betula, L.

Of the five birches commonly found in this State all are more or less valuable or worthy of cultivation. The fruit of the red or river birch and of the canoe birch matures in summer, about June. The small seeds should be removed from the cone-like fruit and sown broadcast at once in moist beds. Of course the plants must be shaded, at least during the first season's growth. They had better remain in the seed beds for two years. The fruit of the three other birches, black, yellow and white, matures in fall. Their seeds should be kept in damp sand until spring. Sow as early as possible and keep the beds moist during the summer, also shade the plants. In one year these may be removed. Most of the birches will grow on poor soil and may be used as nurse trees for more valuable broad-leaved species. Conifers suffer from having their tender shoots whipped off in a strong wind by the action of the slender stems of these trees and consequently should not be planted with them.

SMOOTH ALDER.

Alnus serrulata, Willd.

Alnus rugosa, (Du Roi) K. Koch. See Britton & Brown, Vol. I, p. 512.

Seldom if ever more than a shrub, but of value, especially for holding soil on banks of streams. The seeds should be picked in October and sown broadcast at once on fresh, sandy soil and covered lightly. Roll the beds and give a covering of leaves for the winter. The seeds are frequently sown upon the snow. If seeds are preserved until spring, when they must be sown very early, keep them in damp sand and in a cold place. Shade the beds during the summer.

IRON WOOD, HOP-HORNBEAM.

Ostrya Virginica, Willd.

A slow growing tree of the poorer soils. It is usually found in the shade of oaks, maples and the larger trees. The fruit resembles the hop. It matures in September. The nut-like seeds should be sown at once and even then may not sprout until the year following. It may be used to plant up blanks, or open places on rocky slopes.

WATER BEECH, HORN BEAM.

Carpinus Caroliniana, Walt.

Usually nothing more than a shrub, though sometimes becoming a tree 25 feet high and a foot in diameter, growing along streams in rich soil. The wood, similar to that of iron wood, is used for levers and turnery work. The fruit matures in autumn and the nut-like seeds should be sown at once in moist, sandy soil. Usually they will not come up until the second year.

OAKS.

Quercus, L.

The oaks may be divided into two general classes, namely the white and the black oaks. The white oaks are those having leaves with round lobes, not being bristle-pointed. The acorns ripen in one year and are sweet to the taste. The black oaks are those the leaves of which have bristle-pointed lobes. The acorns mature in the second year and are bitter to the taste.

Of the first class there are in Pennsylvania, worthy of being cultivated, the following:

White Oak. Quercus alba, L.
Post Oak. Quercus stellata, Wang. Quercus minor, (Marsh.) Sarg. See Britton & Brown, Vol. I, p. 520.
Bur Oak. Quercus macrocarpa, Michx.
Swamp White Oak. Quercus bicolor, Willd. Quercus platanoides, (Lam.) Sudw. See Britton & Brown, Vol. I, p. 521.
Chestnut Oak. Quercus Prinus, L.
Yellow Oak. Quercus Muhlenbergii, Engelm. Quercus acuminata. (Michx.) Sarg. See Britton & Brown, Vol. I, p. 522.

Those of the black oaks are:
Red Oak. Quercus rubra, L.
Scarlet Oak. Quercus coccinea, Wang.
Black Oak. Quercus tinctoria, Bartram. Quercus velutina, Lam. See Britton & Brown, Vol. I, p. 517.
Pin Oak. Quercus palustris, Du Roi.
Spanish Oak. Quercus falcata, Michx. Quercus digitata, (Marsh.) Sudw. See Britton & Brown, Vol. I, p. 518.

All of the oaks will grow on poor soil, but since rapid growth of oak produces better wood the better part of soil allotted to forest should be given to them. The acorns mature in fall and may easily be gathered from under the old trees. Those of the black oak class may be sown at once, because of their bulkiness for keeping and because there is no danger from rodents. Those of the white oaks, while they lose their power of germination very soon, but because of the danger from rodents, should be kept until spring in damp sand and in a cool room, or buried with sand in a well drained place. The plants have long taproots and some suggest that the acorns be sown at once in the plantation where the seedlings are to remain. If so done, plough shallow furrows every three feet apart and drop the acorns at a distance of every two or three inches in the furrow. For several years the seedlings may be cultivated as convenient. If sown in beds scatter from three to four hundred acorns on a bed four feet each way. In one year the plants may be removed and set one foot apart in rows three feet from each other.

CHESTNUT.

Castanea sativa, Mill., var. Americana, Watts. & Coult.

Castanea dentata, (Marsh.) Borkh. See Britton & Brown, Vol. I, p. 515.

In the Forestry Report issued by this State in 1895 the following reasons are given for the cultivation of chestnut:

"1. It will grow on almost any kind of soil, from a river flat to a mountain top, although it is not at its best on limestone soils.

"2. It grows with great rapidity.

"3. When cut it reproduces a valuable coppice growth in a few years.

"4. Its product, wood and fruit, will always be in demand.

"5. There will be an increasing demand for it in the future because of the tannin which it contains."

The fruit matures in October, being released from the burs by the first frost. The chestnuts may be sown at once, which is preferable, or they may be mixed in moist sand and buried until spring. Have the soil well prepared. Some sand mixed in the beds will be good. Shade the seedlings during summer. Set out as the oaks, in rows three feet apart and at a distance of one foot from each other in the row. Alternate rows may be set with white pine, or in order to afford cultivation corn might be planted in alternate rows.

BEECH.

Fagus ferruginea, Ait.

Fagus Americana, Sweet. See Britton & Brown, Vol. I, p. 514.

The beech is a tree which should be planted in soil where its roots can get plenty of moisture. The fruit is mature in October and may be gathered from under the old trees. Sow in furrows six inches apart, the seeds touching each other in the furrows. Shade well. If possible sow the seeds broadcast within an open pine woods, after having raked off the needles. Cover the seeds lightly. The plants may be set out at from two to five years old. It endures shade and may be set under oak, pine, etc.

WILLOWS.

Salix, L.

All of the willows are so easily propagated from cuttings that it is not necessary to waste time by trying to raise them from seed. Last year's shoots can be cut and buried over winter. In spring take an iron bar and make a hole large enough for the cutting to go in. Leave one bud above ground and pack the soil firmly about the remaining part of the cutting.

ASPEN, QUAKING ASP.

Populus tremuloides, Michx.

The poplars are rapid growers. They are found usually along banks of streams, but also on higher ground. In the west the aspen is found coming up on land that has been cleared of other trees, either by "slashings" or by fires. There it prepares the soil for better species, as for instance white pine, and it protects the young plants. The fruit ripens in May or June. The seed is small and "cottony." It should be sown at once in a cool situation and covered lightly. When one or two years old set out in a plantation, as close as convenient. It may branch when young but permits pruning. It may be raised easily from cuttings.

COTTONWOOD, CAROLINA POPLAR.

Populus monilifera, Ait.

Populus deltoides, Marsh. See Britton & Brown, Vol. I, p. 493.

A tree whose wood is being extensively used for paper pulp. It is a rapid grower and adapts itself easily to almost any soil. The most vigorous growth, however, is found on rather moist soil. Thirty cords of pulp wood to the acre, under average circumstances, might be expected after fifteen or twenty-five years. The tree is frequently found here as a shade tree. The seeds mature in July and should be sown at once. The seed beds should be kept moist. By the next fall seedlings could be set out in the plantation at four or five foot distances from each other. It will make a good nurse tree for white pine, if mixed with it. The quickest and cheapest method of propagation is from cuttings.

WHITE PINE.

Pinus Strobus, L.

It is not necessary to state the uses of this tree nor should it be necessary to state that it ought to be cultivated extensively. It is a rapid grower and prefers poor soil, yields early returns and is very valuable when mature—what more is wanted? The seeds mature in fall of second year and as soon as the cones become pitchy (in August or September) pick them and keep in ordinary living room or some other dry place during winter in bags or on a slat frame, having something to catch the seeds as they fall from the cones. Seventy-five degrees Fahrenheit is sufficient heat to open the cones that the seeds may drop out. Sow broadcast early in spring. Cover lightly and roll the beds. They must be protected from the sun in summer. If the beds become very wet sprinkle dry sand over them as soon as possible. "Damping off" is said to be prevented in this way. If one year old plants are not used in the plantation they had better be transplanted to nursery rows, the rows six inches apart and plants about two inches apart in the rows. During the winter cover with leaves and transplant in spring. Two year old plants may be used safely. If possible have some nurse tree two or three years in advance of the pine, or a rapid grower, set in alternate rows, or two rows of pine to one of the other. Three feet in the row is sufficient. It is worthy of a place as an ornamental tree.

PITCH PINE, YELLOW PINE, JACK PINE.

Pinus rigida, Miller.

This pine has needles in threes. The cones take two or three years to mature. They should be gathered and treated as white pine. With all pines the seeds must be kept dry during the winter. The oil in them will preserve them so there is very little danger of their losing the power of germination for several years if they are not exposed to moisture. Sow the seeds broadcast in sandy beds in spring. Seedlings can be set out in spring when two years old. They are very sensitive to being transplanted so their roots should be carefully protected. It grows where the soil is extremely poor, but slowly.

SPRUCE PINE, YELLOW PINE.

Pinus mitis, Michx.

Pinus echinata, Mill. See Britton & Brown, Vol. I, p. 52.

Leaves usually in pairs. The cones are somewhat longer than those of the pitch pine but not so large in diameter, proportionally, They mature in one season. Formerly there was considerable yellow pine in this State but it has become very scarce. The tree reaches a large size and its wood is valuable. It is not hard to raise from seeds, which should be treated as those of the other pines. It is a fairly rapid grower and is adapted to dry, sandy soil and to poor slopes.

The red or Norway pine (Pinus resinosa) may be propagated as easily from seed as the other pines.

RED SPRUCE.

Picea nigra, var. rubra, Engelm.

Picea rubra, (Lamb.) Link. See Britton & Brown, Vol. I, p. 55.

A tree of the highest ridges and cool northern slopes. The cones are small and unusually plentiful. They may be gathered any time after October. By heating the cones some, the seeds will readily fall from the scales. They should be sown in early spring in soil somewhat sandy. Cover the seeds lightly and roll the beds. Shade the seedlings well and do not let the beds become too dry. The plants may be put in the plantation when two years old or they may be transplanted to nursery rows and set out when four years old. They have shallow roots and may be used on rocky slopes. In regular plantations three feet is the proper distance at which the plants should stand from each other.

BLACK SPRUCE.

Picea nigra, Link.

Picea mariana, (Mill.) B. S. P. See Britton & Brown, Vol. I, p. 55.

Somewhat smaller than the red spruce. It prefers "sphagnum-covered swamps." Propagation is same as for the red spruce.

HEMLOCK, HEMLOCK-SPRUCE.

Tsuga Canadensis, Carr.

The cones of the hemlock mature in one year. They are small and egg-shaped, drooping from little foot stalks when ripe. Gather in October. After the seeds have been removed from the cones, keep them in a dry, cool room until spring. Sow broadcast in well prepared beds. Rotten wood mixed with the soil will no doubt insure better success. Moisture and shade are necessary for the young plants. In two years they may be set out finally or transplanted and set out when four years old. While the tree is found in moist and cool places it seems to do well in other situations. The hemlock is, when young, perhaps the slowest grower of all our forest trees and will be the hardest to perpetuate as a forest tree.

BALSAM FIR, BALM OF GILEAD FIR.

Abies balsamea, Miller.

Frequently found in the northern and colder parts of the State. It makes a fairly rapid growth in well drained soil and can be used for planting along roads or walks. The cones may be gathered in autumn and dried slightly. The scales of the cones will have to be separated from the seeds. They can then be treated as those of the black spruce.

LARCH, TAMARACK, HACKMATACK.

Larix Americana, Michx.

Larix laricina, (Du Roi) Koch. See Britton & Brown, Vol. I, p. 54.

The tamarack is a northern tree and is found only in the cooler parts of the State. While it may be grown on dry soil it prefers and is usually found in cool swamps. It is a valuable tree and is said to be raised easily from seeds. The small cones mature in September and may then be gathered from the trees. Drying the cones will release the seeds which may be kept in a cool dry place until spring. Sow thinly over the beds and press the seeds into the ground, giving them a slight cover. Protect well during summer. The next fall they may be easily planted out at about five foot distances. Their growth is fairly rapid.

ARBOR VITAE.

Thuya occidentalis, L.

A tree that is of more value perhaps as an ornament than as a tree for forestry purposes, in this State. The stems are used for poles and posts. The cones mature in September or October. It is grown easily from seeds if treated as the other conifers. Two years in the nursery beds is sufficient for the young plants. They may then be placed in the plantation. It occurs naturally, but sparingly in this State.

CEDAR, RED CEDAR, SAVIN.

Juniperus Virginiana, L.

Very common throughout the State, but never reaching a very large size. It is a slow grower. The fruit is a berry made up of several fleshy scales enclosing two or three seeds. The berries may be gathered in November. They should be macerated in warm water or put in strong lye made from wood ashes for several days until the seeds can be washed clean. Keep the seeds dry and cool and sow early in spring. Cover the beds with leaves as it is likely that the plants will not come up until the next year. They may be set out after two years, or transplanted when four or five years old. Set at three feet from each other. This tree is very valuable for fence posts.

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Bulletin 4

Commonwealth of Pennsylvania

DEPARTMENT OF FORESTRY

A REPORT

ON

THE CHESTNUT TREE BLIGHT

THE FUNGUS, DIAPORTHE PARASITICA, MURRILL

BY JOHN MICKLEBOROUGH, PH. D.
MAY, 1909

HARRISBURG:
C. E. AUGHINBAUGH, PRINTER TO THE STATE OF PENNSYLVANIA
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LETTER OF TRANSMITTAL.

Hon. Robert S. Conklin,
Commissioner of Forestry:

Sir: I have the honor to present my report on the deadly fungus, *Diaporthe parasitica,* that has caused the destruction of many chestnut trees within the borders of the State of Pennsylvania. The investigations have been carried on to ascertain the presence of this disease in the valleys of the Delaware and Susquehanna rivers. Accompanying the report of its geographical distribution is an account of its life history, its prolific propagation, the damage already done, and suggestions for remedial treatment.

Thanking you and your associates for many courtesies, I have the honor to be,

Most respectfully yours,

JOHN MICKLEBOROUGH, Ph. D.

cont.
28 Nov. 19 direct

THE CHESTNUT TREE BLIGHT.

BY JOHN MICKLEBOROUGH, PH. D.

The devastation produced by the chestnut tree fungus, *Diaporthe parasitica,* is arousing the attention of State authorities and deeply concerns the owners of woodland, also the owners of chestnut groves and chestnut orchards. Nothing more serious has ever appeared in the forests of this country than the destructive work of this parasite. Its presence is known by the writer from personal examinations to extend from near the northern boundary of Maryland, through south eastern Pennsylvania, across New Jersey and New York. The line of inspection covers a distance of nearly two hundred and fifty miles. On Long Island the disease has spread for fifty or sixty miles with great rapidity, and is most prevalent and its ravages the most deadly.

In December, 1908, I was invited by Dr. Jane Baker, the physician in charge of Chester County Insane Hospital, to speak before an Educational Conference at Embreeville, Pa. On this visit several infested chestnut trees were found. The disease was not prevalent.

The inspection of forests to ascertain the presence of the blight, under the direction of the Department of Forestry, began March 29th, 1909. The counties first to receive attention were, Dauphin, Lebanon, Berks (west), Cumberland, and Franklin. This is a rich agricultural section of the State lying between South Mountain and North Mountain or the Blue Ridge. The Lebanon and Cumberland valleys are a limestone formation and very few chestnut trees are to be found until the mountain slopes are reached where the chestnut growth is abundant. A careful inspection of the forests was made on each side of the Susquehanna where the river cuts through the Blue Ridge to the north of Harrisburg, and at Middletown where it wends its way beyond the broken ridges of South Mountain. An examination of chestnut forests was made at Wernersville in Berks County, and as far west as Mont Alto in Franklin. Examinations were made along South Mountain at Hunters Run, Mt. Holly Springs, and farther south at Idaville. *The Chestnut tree blight was not found to the north and west of South Mountain.* It becomes an interesting question whether the valley from twelve to twenty miles or more in width between North and South Mountains may not act as an effective barrier to the progress of the disease into the interior of the State. At Mont Alto, the State Forestry Academy was visited. This institution is doing most excellent work. The instructors are able and practical men, and the students are enthusiastic lovers of nature.

The value of having trained men in the service of the Department can not be too highly estimated. The next region of the State to be inspected was to the south and east of South Mountain. From the city of Lancaster three trips were made by trolley, first to Ephrata, second to Quarryville, and the third to Gap. At each of these places the blight was found. Specimens of bark were taken from trees six and eight inches in diameter. Infected sprouts or coppice about stumps were obtained. Under the microscope spores of the deadly fungus in uncountable millions were shown. The disease was most prevalent at Gap. Ephrata in Lancaster is south of South Mountain and is only twelve miles from Wernersville in Berks county where the forests of South Mountain furnished no evidence of the disease.

At Gap, Mr. Levi Wise has a chestnut grove of one hundred trees, consisting of Paragon and Spanish grafts. A distinction is made between a chestnut grove and a chestnut orchard. When the stock is a native chestnut and the scion for grafting is a foreign variety or species, such as Paragon, Spanish, Japanese, Numbo, Ridgely, Alpha, etc., it is termed a grove. When young seedlings are set out in rows, whether grafted or not, it is called an orchard. The blight had invaded Mr. Wise's grove. Infected spots were found on the native stock and also on grafts. The following note was made at the time of the inspection: "The Paragon and Spanish grafts are unusually healthy considering the number of infected native trees in the immediate vicinity." On these trips in Lancaster county it was my good fortune and very great pleasure to have the company of Deputy Commissioner of Forestry, Mr. Irvin C. Williams. It was decided at once to make an Experiment Station at Gap and to plant twenty-five Japanese chestnut trees and to start with one hundred grafts of the same species. Surrounded by natural woodland in which the disease is quite prevalent, here was an opportunity to test the immunity or resisting power of three foreign chestnut growths side by side.

Through the generosity of Mr. Isaac Hicks, a nurseryman at Westbury, Long Island, twenty-five Japanese chestnut trees were donated for the experiment and all the Japanese scions that could be used. Three of these Japanese trees will probably bear this year, and all should begin to bear next year. Mr. Wise had made one hundred new grafts this season, using Paragon scions on native stocks. Within half a mile of Mr. Wise's grove there is another small grove of Paragons on the property of Mr. Thomas J. Bitzer. Seven of the Japanese trees were given to Mr. Bitzer. During the past winter, the writer has had in his laboratory specimens of bark and limbs and sprouts of native chestnut, Paragon and Japanese, all infected. And yet from the examination of hundreds of trees of each kind, and nine chestnut groves in widely separated localities it is firmly believed these chestnut groves and orchards may be protected from the ravages of this fungus growth.

Since the blight was found at three places on the east side of Lancaster county, an inspection was made at two points on the western border. At Martic Forge, or Marticville, the blight was found on native chestnut trees in the immediate vicinity of, and in the grove of the Paragon Nut Co. The grove contains nearly four hundred acres. About two hundred infected trees had been removed from the grove. The wood was on a pile at the woodshed. Many of the sticks on the wood pile were infested with living spores. The blight is a bark disease and when a tree is felled the bark should be burned at once. When the bark has been removed, the wood may be used for various purposes. The bark on the stump should be burned for two or three inches below the surface of the ground. Spores will be developed and propagated many months after the tree has been cut down. Specimens of infected bark have been kept in sealed test tubes for more than nine months and on examination the spores were alive and as active as on the day when selected for the experiment. Martic Forge is thirteen miles directly south of the city of Lancaster and about four from the Susquehanna river. The next inspection was made at Marietta, located on the Susquehanna and about sixteen miles directly west of Lancaster. At this place Mr. John G. Engle has a grove of one hundred and twenty-five trees, chiefly Paragon. His grove is in excellent condition. There was no evidence of the blight and no indications that it has ever existed on his property. The grafting which had been done by him several years ago is as perfect in the union between scions and stocks as can well be obtained. Infected trees on other property were found at Marietta. Specimens of bark and branches showing the disease were taken from native growth and also from Paragon grafts from two small groves in the vicinity which had been seriously infected. In Lancaster County the disease was found at three places on the eastern border and at two places on the west. In Adams county, at Gettysburg, there is no chestnut growth to speak of, but in the northern part of the county at Idaville the forests are chiefly chestnut and oak. This village is on the south side of South Mountain. Much care was exercised in the inspection at this place and hundreds of trees on several lots were examined. No evidence could be obtained of the presence of the disease at Idaville.

The next county to receive attention was Montgomery. Specimens showing the infection were obtained from the trees on the campus of Haverford College. Three estates near Haverford were examined. The chestnut was the prevailing tree in this portion of the State. In one case all the chestnut trees had been carefully treated by cutting off all dead limbs and each wound covered with tar or paint. All the trees, several hundred in number, on the estate of Mr. Harold Pierce were in a fine healthy condition. On two other estates, dead trees had been felled during the winter, but in one instance the pile of cordwood contained abundant evidence that the fungus parasite had done its deadly work, and in the other all the wood and brush had been burned, but an examination of the bark on the stump revealed the fact of the existence here of enough living spores to infect all the trees of the neighborhood, should they find a lodgment on their favorite hosts, the chestnut trees.

The next trip was to follow up the valley of the Susquehanna to the north of Harrisburg. At Sunbury in Northumberland county, the North Branch and the West Branch unite to form the Susquehanna river. At this point the forests for a distance of ten miles, along the river and its two main branches, were examined. The chestnut growth was not so abundant as along the slopes of South Mountain. No evidence could be obtained of the presence of the blight. A side trip was taken up the Shamokin valley. This gave an opportunity to examine the Paragon grove of Mr. C. K. Sober, situated about twelve miles in a direct line from Sunbury. This famous grove contains about four hundred acres and all the trees bearing fruit. Here is a demonstration that waste mountain land, on which the native chestnut grows, may be redeemed and become a profitable investment. One year Mr. Sober had two thousand bushels of Paragon chestnuts to sell. And since the selling price has ranged from $5 to $12 per bushel, one can estimate the income from this source. In his nursery, he had approximately three hundred thousand seedlings and about one hundred thousand of these were to be grafted in the spring of 1909. In large banks or mounds of sand there were one hundred bushels of nuts which would be planted early in May. The object on all trips was primarily to inspect the natural woodland. The native growth of chestnut on Herndon Knob was examined and also the opposite ridge two miles away across the valley. There was no sign of the blight in Shamokin valley nor in any other portion of Northumberland county that was visited.

At Sunbury an inspection was made to the east and south of the Susquehanna, and at Bloomsburg it was to the north or on the opposite side of the river. No sign of the blight could be found in Columbia county. With Mr. S. C. Creasy a drive was taken to Millville, twelve miles from Bloomsburg on the Susquehanna. The chestnut trees are very abundant in certain parts of Columbia county. Mr. Creasy is well informed on all subjects pertaining to forestry in its practical bearing and his company was a great delight. The next stop was made at Wilkes-Barre. In company with Mr. J. E. Patterson a trip was taken to Glen Summit Springs, about nine miles south of Wilkes-Barre. In these trips frequent stops were made and a dozen or more investigations were undertaken. Luzerne county did not furnish a single specimen that gave any indication of the presence of the blight.

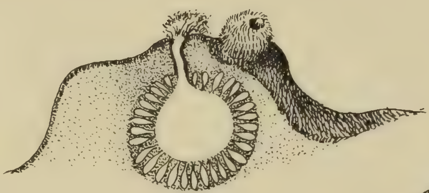
At Scranton on the Lackawanna river, a tributary of the Susquehanna, there is little or no chestnut growth. Valuable information was obtained from Mr. T. J. Snowden, a lumber dealer, as to the character of what little forest growth remains in that part of the State. In his lumber yard there were four hundred chestnut posts from six to eight feet in length. These had been cut at Hawley near the border of Pike county. Having been recently cut, the bark which was on the posts would have given evidence of the disease had it existed. There was no sign of the blight on any of these posts.

The next stop was made at Carbondale in the northeasterly part of Lackawanna county. Here as at Scranton, the lack of forests in general, and especially of chestnut trees, precluded an extended investigation. Going eastward over the divide between the Lackawanna river and the Lackawaxen creek or in a broader sense over the highland which separates the watershed of the Susquehanna from that of the Delaware river, the work was taken up at Honesdale. No chestnut growth could be found within ten miles of Honesdale, was the information received from Mr. Kreitner of that town. Since the writer had found the blight at Milford on the Delaware, in Pike county it became an important question to ascertain if it had spread westward and been carried into the upper portions of the Susquehanna valley. The disease exists at Milford and farther north to within three miles of Matamoras, Pa., opposite Port Jervis, N. Y. With Mr. E. T. Riviere of Milford, infected trees were found to the west and again to the south of Milford. Specimens of the blight were taken about one mile from the Camp of the Yale Summer School of Forestry on the estate of Mr. Gifford Pinchot, Chief of the U. S. Forest Service.

To sum up for the Susquehanna valley. The chestnut tree blight was *not found* north of South Mountain. It was found in several localities south of South Mountain along the Susquehanna and on the watershed lying to the east of the river.

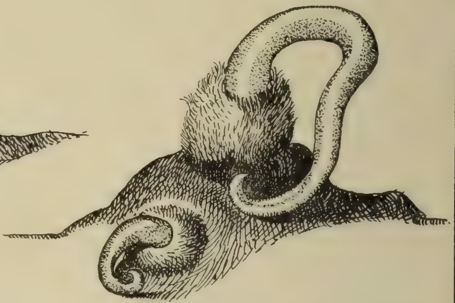
In the Delaware valley infected chestnut trees were found at Embreeville in Chester County, on the Brandywine, a tributary of the Delaware river; at Haverford in Montgomery county; at Trenton, N. J., and across the river at Morrisville in Bucks county; near Easton in Northampton county; and at Milford and Matamoras in Pike county. Nowhere in Pennsylvania has the blight become so virulent

1.



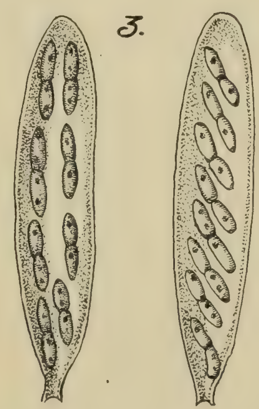
The flasks or perithecia, with long tubes. Magnified.

2.



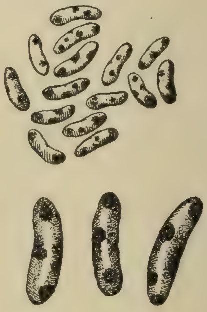
Thread mass of summer spores. Magnified.

3.



The 8 spored sacks. Magnified.

4.



Spores from thread mass. Highly magnified.

and malignant as in New York, especially on Long Island. In the winter of 1908, over eleven hundred chestnut trees were felled in Prospect Park in Brooklyn, N. Y. Many of them were dead and the others so infected that removal was the best course to pursue. Forest Park, is another large park in Brooklyn. It contains 536 acres of which about 350 acres are natural woodland. The Park Commissioner reports fifteen thousand or more chestnut trees in Forest Park.. At this date, May, 1909, these trees are standing, but greater havoc from blight or insect pest on forest trees has probably never been excelled in deadly malignity. The disease is so prevalent, that it is proposed to cut every chestnut tree in the Park. On many estates on Long Island similar conditions exist.

THE LIFE HISTORY OF THE BLIGHT.

Neither insect pests nor blights can be dealt with successfully until the life history is known. It is almost useless to strike at one of these supposed antagonists in the dark. Is it much better to know your antagonist, where it lives, and how and when it is propagated. As to the chestnut blight, its general appearance should be known at different stages of growth and for each season of the year. Does it have the same appearance in the resting stage of winter as in the rapidly growing condition of summer?

The first scientific description of the chestnut blight was given in 1906 by Dr. Wm. A. Murrill of the Bronx Botanical Garden, New York City. After a year or more of study and experiment the fungus was proved to be a new species. It belongs to the class known as the sac-fungi and to the genus Diaporthe of which more than one hundred species are known to science. The scientific name of this blight is *Diaporthe parasitica.*

Many of the fungi derive their nourishment from decayed vegetation. Such are the common brackets or shelves on stumps and logs and are properly called saprophytes. Other saprophytes live on decayed animal matter. When one looks at a puff-ball, mushroom, or bracket on a log, it is the fruiting body of the fungus that is under observation. Besides this there are hundreds of fine threads a yard or more in length penetrating the mould or decayed log. These threads or mycelia take up the nourishment and produce the fruiting body. Some fungi, however, derive their nourishment from *living* plants or animals, and are consequently called parasites. Ringworm that attacks man is a fungus parasite, *Trichophyton tonsurans.* The deadly chestnut blight is also a fungus parasite. The ringworm burrows beneath the skin and the chestnut blight lives in the bark and derives nourishment from the new cells of the cambium. The other hundred or more species of Diaporthe live, as a general rule, on decayed wood and do not attack the living. They are saprophytes and not parasites. This distinction should be kept in mind.

The saprophytes are found on *dead* limbs and trunks of the locust, mountain maple, hickory, ironwood, ash, chestnut, basswood, elm, walnut, oak, red maple, beech, willow, sassafras, golden rod, aster, and many other plants. After a forest fire many forms of saprophytes may be found on the *dead* limbs and trunks of various trees.

What are fungi? They are plants produced by spores and in this respect differ from seed-bearing plants. The ferns and the mosses are also spore plants and are higher in the scale of plant life than the fungi. The fungi include the moulds on bread, cheese, and preserved fruits; mildews, as the downy mildew causing the rot of the Irish potato; rusts on wheat; black-knot on the plum and cherry; mushrooms, edible and poisonous; yeasts; puff balls, etc.

The total number of plants of all kinds known to science is about two hundred thousand species. There are about fifty thousand species of fungi, and of this number about fifteen thousand belong to the sac-fungi (Ascomycetes). The sac-fungi are a very destructive form of fungus growth and produce a number of diseases on account of the fact that many of the species have the parasitic habit. In this division of fungi, there are the leaf-curl of the peach; the black-knot of the plum and cherry; many of the powdery mildews; the large morels, prized for food; the yeast plant, known to makers of bread and beer; the green mould on cheese, as well as the deadly chestnut blight. After the chestnut trees or sprouts have been killed by the blight. numerous other fungi will attack the dead wood. These must not be charged with the destruction of the tree or sapling. These are the scavengers that come to feed upon the dead and are known as saprophytes. Between thirty and forty different species of fungi are known to attack dead chestnut limbs, stumps, and logs.

PROPAGATION OF THE CHESTNUT BLIGHT.

The Diaporthe parasitica is propagated by at least two kinds of microscopic spores. One kind of spore is developed in minute sacs. Each sac contains eight spores and nature fills each tiny sac with the eight spores as uniformily as one finds four legs on a dog and two on a bird. These are sometimes called the winter spores. These spore-sacs are developed in minute flasks resembling carafes or long necked water bottles and are formed abundantly in the autumn. In this way the fungus tides over the winter. Another kind of spore more minute than the winter spore may be found in thread like masses in early spring and during the summer. These are called summer spores, or conidial spores. Conidial is derived from the Greek word meaning dust. Sometimes the thread mass or spores is more than half an inch in length. Such a thread will furnish millions of spores.

These two kinds of spores are different in origin but the same in power in producing the young plant. For the benefit of the microscopist it may be well to state, the winter or sac spores are sexual spores and the conidial or summer spores are non-sexual. It would take from five to six hundred of the tiny sacs placed end to end to measure one inch and about three thousand of the sac spores end to end to measure an inch, and of the minute summer spores eight to nine thousand. Both kinds of spores are produced by countless millions. A section of a limb twelve inches in length and one inch in diameter will furnish an ample supply of spores to infect all the chestnut trees in a county. The minute spores are carried by the wind, on the feathers of birds and the fur of squirrels, and find a lodgment where the bark is abraded and especially in the fork of the limbs or more tender branches. The spore immediately sprouts, and procures its nourishment from the new wood or cambium layer. These newly formed wood cells have very thin delicate walls and are full of sap. Thus the cambium furnishes the parasite with ample nourishment. The walls of the new wood cells are broken down by the growing parasite and the bark begins to change color from a healthy olive green on twigs and slender branches to a reddish brick color, and the parasite shows a tendency to girdle the limb or trunk. As soon as the girdle is complete, all nourishment is cut off from the parts beyond the infected portion. The result is the same whether the girdling is done with an axe, a saw, or by a parasite. Large trees are girdled and killed in two or three years. During the summer of 1908 many branches of chestnut trees showed signs of decay and the green leaves of spring withered long before the frosts of autumn had touched the foliage. So far we have spoken only of the growing fungus. Its work during this stage is carried on in and beneath the bark. It is technically speaking a hypophloeous disease. The next stage is known as the fruiting period. As the fungus grows it finally matures and develops the fruiting body, or rather fruiting bodies. Its growth is now outward, through the pores in the bark. In old trees the fruiting or spore producing bodies are in the long crevices or fissures of the bark. A piece of a limb kept in the laboratory where the changes in the weather will not affect it, will soon be thickly beset with small yellow pustules, resembling little yellow cushions of velvet. These are fruiting bodies of this parasite. Running through the pustule are some dark lines. These are the necks of the flasks or perithecia at the base of the pustule and are situated just beneath the outer layer of the bark. These flasks are lined with the eight-spored sacs. In early spring and during the summer the thread masses consisting of the summer or conidial spores will be found. These threads are dissolved and washed away by the rain and the spores are blown about by the wind. These developments may be seen best on specimens in the laboratory. A common fruit jar, in which is placed a four or six inch piece of an infected limb, will, in thirty-six or forty-eight hours show signs of the fruiting bodies. First put the stick into water for two or three minutes then transfer it to the jar in which there is less than half an inch of water. The jar is closed and kept at summer temperature. A warm cellar is most convenient, since the fungus grows in the dark as well as it does in the light. In this way the writer has had an abundant supply during the past winter of fruiting pustules on limbs of the native chestnut, Castanea dentata; on the Japanese chestnut, Castanea crenata; and on the Paragon, which is probably a variety of the Spanish or sweet chestnut, Castanea vesca. From these specimens the two kinds of spores were at hand during the entire winter.

Foreign chestnut trees sometimes attain an immense size, and are quite common in the south of Europe, in Spain, Italy, Switzerland, and Germany. The fruit or nut which is two or three times the size the American nut is much used as an article of food. The large kernel is frequently ground into meal and is used to thicken soups, and even bread is made of the chestnut flour. The largest foreign chestnut tree is on the slope of Mt. Etna, in Sicily, and has a circumference of 190 feet, and is known as the "Castagno di cento cavalli," the chestnut of one hundred horses.

There is no lack of opportunity for spores to find an entrance beneath the bark of a chestnut tree, large or small. The wood is brittle and the storms of winter leave many broken twigs and limbs. The small boys and older nut gatherers have clubbed the trees and left many a scar. Insect borers and woodpeckers have made openings in the bark in many places. The forks of the branches seem to be favorite places for the lodgment of spores. In a young tree ten or more points of infection have been observed at the break of the bark in the forks of the limbs.

The propagation is readily carried on wherever there is a supply of spores. The transportation and ready access to the cambium wood cells are well provided. On Long Island an isolated tree, more than a mile distant from any chestnut growth was infected.

IMMUNITY OF OTHER TREES.

All the other forest trees seem to be immune. There are fungus growths of the saprophytic type on all forest trees. Abundant spores of another species of fungus were found upon the branches of several oak trees. The trouble was limited to the under side of the branches, and there was no tendency on the part of the fungus to invade the new cells of the cambium or to girdle the branch. An examination of

THE CHESTNUT BLIGHT AS FULLY DEVELOPED BY INCUBATION.

(From a Color Photograph.)

the locality revealed the fact that it had been swept by fire a year or more ago and the under side of the limbs had been injured. The fungus was merely doing scavenger work, and living upon decayed vegetable tissue. Many times questions have been asked about the horse chestnut, AEsculus hippocastanum. The common horse chestnut or buckeye is a near relative of the maple and is quite unlike the oak, chestnut, and beech, belonging to the same natural order, Cupuliferae, from the fruit being contained in a cup or burr. Another question,—is the chestnut oak immune? It is just as immune as any other oak. Up to this date the writer has not found the deadly chestnut fungus on the chestnut oak, sometimes called rock oak, or Quercus Prinus, L. Hundreds of the chestnut oaks have been examined and although growing side by side with diseased chestnut trees, no case of an infected oak has been discovered.

The variety of chestnut called the Paragon, is quite susceptible to the disease. While the Japanese variety or species is not immune, it is certainly more resistant than the native or the Paragon. In one locality eleven Japanese chestnut trees were in a perfectly healthy condition and bore abundance of fruit in the summer of 1908, although in the immediate vicinity there were many native trees all badly infected. Within one hundred yards of these eleven trees there was a Paragon infected in several different places. In a nursery of twelve or fifteen hundred young Japanese chestnut trees, there were many young native chestnut seedlings from five to ten feet in height. It was almost impossible to find a native tree free from the infection. On the other hand many of the Japanese were immune, yet on an extended examination some five or six of the Japanese were infected, and under hothouse treatment developed a rich supply of spores. Evidently an orchard of Japanese or Paragon chestnut trees can be made profitable and the trees kept in a healthy condition with reasonable care.

ESTIMATED VALUE OF PROPERTY DESTROYED.

The statistics furnished by the United States government show that for the year 1907 over 600,000,000 board feet of chestnut lumber were cut. Valued at $17 per 1,000 the total value would be about $10,000,000 for one year. Besides, there were over $3,000,000 for chestnut cross-ties. Much timber is used in the mines, and also for fence posts and telegraph and telephone poles, and by cabinet makers. The tanneries also use many cords of chestnut wood. The market value of the nuts is no inconsiderable item. In 1908 it would appear, the output of all kinds from the chestnut forests of the United States would aggregate $22,000,000. Should the chestnut blight become as prevalent and virulent as on Long Island, and advance as rapidly over the country as it has moved eastward on the Island, it is only a matter of a few years when this source of income will be reduced many millions per annum.

The number of chestnut trees on an acre of natural woodland has been counted in New York, New Jersey, and in Pennsylvania. In some counts there were from forty to fifty chestnut trees to the acre disregarding any tree under two or three inches in diameter. In Somerset and Morris counties, N. J., an average of thirty chestnut trees to the acre would be a low estimate for many pieces of woodland. The damage already done by the chestnut blight in the States of New York, Pennsylvania, and New Jersey would not be less than $12,000,000; and when the special value from location on lawns and the aesthetic value in landscape features are considered, two or three millions could be added to this estimate.

REMEDIAL TREATMENT.

Let us notice the conditions in the life history of the chestnut blight. It is a vegetable growth and in its development, the threads penetrate the delicate cells of the newly forming cambium. Summer spores are produced from early spring to late autumn. On the approach of winter, the winter spores are developed in sacs and the sacs line the flasks or perithecia, and in this way tide over the severest cold in the resting stage.

In the case of a large tree, if it is infected at several points it would be advisable to cut it down at once. All the branches and the loose bark should be burnt. The wood may be used for various purposes. If allowed to stand, it furnishes millions of spores, and the wood is greatly injured on acount of the attack of saprophytic fungi of various kinds and also certain insect pests. Young trees are destroyed in one or two years after becoming infected. The girdling process is soon accomplished and the cutting and burning of such growth is recommended. First, all undergrowth about the chestnut trees should be removed. An examination of the trunk will soon reveal the healthy or living condition of the new wood beneath the bark. If the layer beneath the bark is destroyed, the extent of injury up and down and around the trunk can be ascertained. If only a limited area has been destroyed, the dead portion, bark and dead wood should be cut away and the wound covered with tar. If only a few limbs are attacked, their removal should not be delayed, if the tree is considered worth treatment. Cover all wounds with tar. The two discouraging features about any treatment arise, first from the difficulty of finding all infected spots on a large tree, and second, many owners of woodland will not give attention to the matter.

A few neglected trees will supply enough spores to infect all the trees for miles around. When the spore has found a lodgment in the layer of new growing cells beneath the bark, only the greatest care will prevent the growth and maturity of the fungus. No forest tree develops sprouts or coppice more abundantly than the chestnut, unless it is the basswood. If the tree is much infected almost invariably the blight will be found on the coppice about its base. A chestnut stump will aid the investigation, for it is sure to be surrounded with an ample supply of sprouts. The bark of an old tree has deep crevices or fissures. In these fissures in the bark of old trees the fruiting bodies are found. If the layer beneath the bark is dead, the deepest part of the fissure should be examined for rows of little red tubercles. Here is where the microscopist finds the sacs with their eight spores, as well as masses of summer spores. By tapping on the thick bark with a hammer, the muffled sound will indicate where the bark is dead. If the area is small it can be cut away and the place tarred.

Many suggestions have been made about injecting some chemical that would enter into the circulation and destroy the fungus. So far nothing of practical value in this line has been accomplished. There are fungicides but if used in sufficient strength to kill the growing fungus, the treatment is about as injurious to the tree as is the disease. Trees kept free from undergrowth and frequently inspected and by cutting as soon as the infection is observed, may be saved and kept in a healthy condition. Chestnut groves and orchards may be protected by careful inspection and prompt treatment. If a tree is badly infected its removal is advised. All bark should be burned at once. The bark of the stump well down into the ground must not be forgotten.

While spraying hundreds of forest trees is out of the question, yet grafted trees in groves or orchards may be benefited by spraying, and a limited number of young chestnut trees on a lawn may be so treated. In the Zoological Bulletin, Oct. 1, 1907, page 190, Prof. H. A. Surface says of the Lime-Sulphur Wash; "It is a fungicide as well as an insecticide and cleans up many of the disease germs, such as those causing leaf curl, leaf spots, rusts, mildews, apple scab, and other diseases of leaves or fruits." The Bulletin of March 1, 1909, contains all necessary information on spraying. Many spores may be washed away, but this infection is protected because it grows beneath the bark and is scarcely touched by spraying.

Trees have been treated by using cotton saturated with Bordeaux mixture. Small bunches of raw cotton saturated with Bordeaux and wrapped in burlap have been tied in the forks of the limbs. To be effective, it would be necessary to treat every fork of the limbs and twigs in this manner and also abraded bark on any part of the tree.

Whether the blight will spread inland must remain a problem for further investigation. At present it appears to be following the coast. On woodland in several localities in Pennsylvania its existence can be shown, yet it can not at present be considered a discouraging menace. On the other hand should the disease spread from tree to tree as is now the case in certain localities in New York and New Jersey, every available measure should be adopted to prevent the propagation of spores by cutting the trees and burning all infected bark.

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OF

FOREST TERMS

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FOREST PROTECTION, FOREST UTILIZATION

FOUND IN

SCHWAPPACH'S "FORSTWISSENSCHAFT"

COMPILED BY
WM. A. A. REINHARDT, A. B.

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A.

Abblättern—peeling off.
Abbrennen—burning off.
Abflutung—flooding off.
abgängig—hypermature.
Abhauen—cutting.
Abhieb—cutting off.
Ableger—layer.
Absatz—sale.
Abschluss—closing off.
Abschürfen—scurfing, scraping.
Abschwächung—weakening.
Abschwemmung—flooding off.
Abstand—distance apart.
Abstellung—removal.
Abstrich—knocking down, abating auction sale.
Abstufung—gradation.
Abtriebsschlag—final felling.
Afterraupe—larva of hymenoptera.
Ahorn—maple.
Akazie—acacia.
Akkordverkauf—agreement sale.
Alterstufung—age gradation.
Altholzalter—age of old wood, old age.
anbauen—cultivate.
anfallen—fell, cut down.
anfertigen—arrange, fix.
angehend—young.
angemessen—suitable.
Anhalt—halt, limit, indication.
Anhaltspunkt—halting-place.
Anpassungsvermögen—adaptability.
Antrieb—inducement.
Anzucht—raising, rearing.
Arbeitsbedarf—labor supply.
  =*kraft*—labor strength.
  =*verdienst*—remunerative employment.
Arsenikweizen—arsenic wheat.
Aspe—aspen.
Ast—branch.
  =*streu*—litter of branches.
  =*stummel*—snag.
Ästung—lopping.
Ätzkalk—quick lime.
Aufarbeitung—working up.
  =*forstung*—afforestation.
  =*frieren*—frost lifting.
  =*hieb*—clearing, cutting up.
  =*lodern*—kindling.
  =*platzen*—bursting.
aufstapeln—to pile up.
Aufstrich—rising auction sale.
  =*treibung*—swelling.
  =*trieb*—driving in.
Auge—bud.
Ausfrieren—frost-lifting.
ausgiebig—abundant.

A.—Continued.

Aushagerung—impoverishment.
=hieb—extraction, cutting out.
auskesseln—to kettle out.
=klengen—to cone, husk.
Ausläuterung—cleaning, clearing.
=roden—uprooting.
=rupfen—tearing out.
=scheidung—removal, separation.
Ausschlag—shoot, sprout.
=schlagsfähigkeit— ability to sprout.
=wühlen—uprooting.
=zugshauung—extraction of old trees from young woods.
austrocknend—dessicating.
Auwaldung—forest on land liable to inundation.

B.

Ballenkamp—ball-plant nursery.
ballenlos—unballed.
Ballenpflanze—ball-plant.
Band—band.
Bankskiefer—Pinus Banksiana.
Baumfrucht—tree fruit.
=schule—nursery.
bedrängen—crowd.
Beeinträchtigung—injury.
Beerkraut—bilberry.
Behandlung—treatment.
Beherbergung—sheltering.
beherrscht—dominated.
Beimischung—admixture.
Belaubung—foliage.
Benutzung—utilization.
Benützungsweise—manner of utilization.
Berechtigungsgrenze—proscriptive boundary.
Bergahorn—mountain maple.
=erle—mountain alder.
Berufs-und Gewerbezählung—Census of Trades and Occupations.
Besamung—seeding
Beschaffenheit—constitution.
Beschirmung—shelter.
Beschneidung—pruning.
Besenpfriem—common broom.
Besichtigung—surveying.
Bestand—stand, crop.
bestandbildend—forming stands.

Bestandesanlage—formation of woods.
=*begründung*—foundation of stands.
=*erziehung*—tending of the crop.
=*loch*—gap in stand.
=*material*—crop material.
=*pflege*—tending of woods.
=*schluss*—crowded stand.
=*schutzholz*—stand shelter wood.
Bestellung—tillage, cultivation.
Betrag—amount
Betrieb—management, system, practice, operation.
Betriebsart—method of management, silvicultural system.
Bezüge—fees.
Biegsamkeit—flexibility.
Biegungsfestigkeit—transverse strength.
Bindigkeit—compactness.
Bindung—binding.
Binnenland—inland.
Binse—rush.
Birke—birch.
Birschpfad—shooting (stalking) path.
Blattwespe—saw-fly.
Blaubeere—bilberry.
=*werden*—becoming blue.
Blockverkauf—block sale, sale of standing trees by area.
Blumentopf—flower pot.
Blutmehl—dried blood.
Boden—soil.
=*decke*—soil cover.
=*feuer*—surface fire, ground fire.
=*flora*—soil flora.
=*pflege*—preservation of fertility.
=*schicht*—soil layer.
=*schutzholz*—soil shelter wood.
=*streu*—soil litter.
=*überzug*—soil cover.
=*vorbearbeiting*—preliminary working of soil.
Bohrkäfer—boring beetle, borer.
Bordelaise Brühe—Bordeaux mixture.
borkig—barky, scabbed.
Böschung—slope.
Brandschaden—fire damages, injurious fire.
=*stiften*—icendiarism.
Breitsaat—broadcast sowing.
Bremse—brake.
Brennholz—fuel wood.
=*kraft*—heating power.

B.—Continued.

Brombeere—blackberry, brambleberry.
Bruch—swamp, bog.
Buche—beech.
Buchenkotyledonenpilz—beech seedling fungus.
Buchenspinner—beech moth.
Buchweizen—buckwheat.
Büschelpflanzung—multiple plantink.
Buschwald—brush wood.

D.

Dampfpflug—steam plow.
Daseinskampf—struggle for existence.
Dauer—durability, permanence.
dauernd—permanently.
Derbholz—wood over 7 cm. wide at the smaller end.
dichtgelagert—compact.
Dickung—thicket.
Doppelpflügen—double plowing.
Douglasfichte—Douglas spruce.
Drahtgeflecht—wire work.
Drainröhre—drain-pipe, draining-tile.
Drehwuchs—twisted growth.
Dreiecksverband—triangular planting.
Drillmashchine—drill machine.
Druckfestigkeit—resistance to crushing.
Düngung—manuring, fertilizing.
Dunkelschlag—seed cutting.
Durchfallast—loose knot.
Durchforstung—thinning.
Durchforstungsbetrieb—thinning system.
durchführbar—practicable.
Durchwurzelung—spreading of roots.
dürftig—poorly, spare.

E.

Edelkastanie—sweet chestnut.
Eggen—harrowing.
Eibe—yew.

E.—Continued.

Eiche—oak.
Eichel—acorn.
Eichenschälwaldung—oak coppice wood for bark.
=*wickler*—oak leaf roller, oak tortrix.
Eigentumsgrenze—ownership boundary.
Einfriedigung—fencing.
=*griff*—attack.
=*halten*—adherence, retention.
=*legung*—beggining, start.
=*schlag*—yield from felling.
=*stufen*—dibbling.
einschlagen—to heel in.
Einzelbaum—individual tree.
=*bruch*—individual break.
=*mischung*—mixture by single individuals.
Einzelpflanzung—planting by single individuals.
=*reihe*—single row.
einzelständig—isolated.
Elementarereigniss—elemental occurrence.
Engerling—cockchafer grub.
Entwässerung—drainage.
Entwicklung—development.
Erdbahn—dirt road.
=*feuer*—ground fire.
=*grube*—earth pit.
=*weg*—dirt road.
Erhaltung—support, retention.
Erhebung—elevation.
Erlös—proceeds.
Ernährungsprozess—process of nutrition.
Erwerbender—laborer, wage-earner.
Erzeugnis—product.
Erzeugung—production.
Erziehung—rearing, raising.
Esche—ash.

F.

Fahrlässigkeit—negligence.
Fallrichtung—direction of fall.
Fällungszeit—season of felling.
Fangbaum—trap tree.
=*knüppel*—trap billet.
=*rinde*—trap bark.
Farnkraut—fern.
Faschine—fascine, faggot-hurdle.

F.—Continued.

Fasernlauf—course of fibres.
Fasertorf—fibrous peat.
Faulbaum—alder-buckthorn.
=*stellen*—rotting.
fäulniswidrig—rot-resisting.
Fegen—rubbing.
Fehlen—failure.
Fehler—defect, fault.
fehlerhaft—defective, faulty.
Fehlmast—fail mast, failure.
Feldmaus—field mouse.
Femelschlagbetrieb—selection system.
Festigkeit—hardness.
Festlegung—determination.
festtreten—stomp fast.
festwalzen—roll fast.
Feuchtigkeit—moisture.
Feuchtigkeitsgehalt—humidity.
Feuergestell—fire line.
=*mantel*—fire belt.
Fichte—Norway spruce.
Finke—finch.
flächenweise—by areas, spotwise.
flachgründig—shallow.
=*wurzelnd*—shallow-rooted.
Floss—raft.
Flugfeuer—flying fire.
Flugjahr—swarm year.
=*sand*—drift-sand.
fm=*Festmeter*—solid, cubic meter.
Forstbenutzung—forest utilization.
Forstdiebstahl—forest theft.
=*frevel*—forest offence.
=*gartenbetrieb*—nursery practice.
=*politik*—forest policy.
=*polizeiübertretung*—forest offence.
=*produkt*—forest product.
=*recht*—forest law.
=*schutz*—forest protection.
=*strafgesetzgebung*—legislation of forest penal laws.
=*technologie*—forest technology.
=*unkraut*—forest weeds.
=*verwaltung*—forest administration.
=*wirtschaft*—forest management.
=*wissenschaft*—forestry.
frevelhaft—mischievous, malicious.
Frostleiste—frost-rib.
=*riss*—frost-fissure.
Fruchtbau—crop cultivation.
=*beisaat*—additional crop sowing.
=*träger*—fruit-bearer.
Frühjahrsaat—spring sowing.
Füllerde—filling earth.

G.

Gasse—lane.
Gassenbruch—lane-break.
Gebrechen—imperfection.
Gefälle—fall.
Gegenfeuer—back-fire.
Gegenmassregel—preventive measure.
Gehölz—wood.
Geissblatt—honeysuckle, woodbine.
Gelände—land, soil.
Gerte—sapling.
Gerbstoffgehalt—tannin content.
Gertenholz—sapling wood.
Gesamtheit—sum total.
  =zuwachs—total increment.
geschoben—shifted.
Gesteinstrümmer—rock particles.
Gestell—see *"Feuergestell."*
Gestör—raft section.
Gesträuch—shrubbery.
Gewerb—occupation, practice.
Gewerbetreibender—mechanic.
geworfen—warped.
Graben—ditch.
Grabestreif—ditch-strip.
Grasflur—meadow.
  =narbe—grass-car, thin cover of grass.
Grenzbeschreibung—description of boundaries.
  =gebiet—border region.
  =stange—boundary pole.
  =zeichen—boundary mark.
  =zug—boundary line.
Grobhacken—coarse hoeing.
  =rinde—coarse bark.
grobschollig—coarse (clods).
Grubenholz—mining timber.
Grundbau—foundation.
  =bestand—ground cover.
  =satz—principle.
Gründigkeit—depth of soil.
grundsätzlich—fundamentally.
Gründüngung—mulching.
Gruppenwirtschaft—group system.

H.

Häckelhacke—pronged hoe.
Hackstreif—hoed strip.
  =streu—cutting-litter.
Hackwaldbetrieb—system of field crops and oak coppice.

Hainbuche—hornbeam.
Halbfabrikat—incompletely manufactured article.
=*lode*—small transplant (21-50 cm.)
Hallimasch—honey fungus.
Harke—rake.
Harz—resin.
=*erguss*— exudation of resin.
=*rüsselkäfer*— resin weevil.
Hasel—hazel.
Haubarkeit—exploitation.
Haubarkeitsbestand—mature stand.
Hauptberuf—chief occupation.
=*holzart*—chief species.
=*nutzung*—principal yield.
Hautflügler—hymenopterous insect.
Hegereiser—see "*Lassreitel.*"
Heide—heath.
=*kraut*— common heather.
Heidelbeere—bilberry.
Heideplagge—heath sod.
heimisch—native.
Heister—high plant, small tree.
Heizungszweck—heating purpose.
Hemmung—hindrance.
Herbstsaat—fall sowing.
herrschend— predominating, dominant.
Hexenbesen—witches' broom.
Hiebsergebnis—felling yield.
=*zug*—felling series.
Himmelsrichtung—cardinal point, direction.
hintanhalten—hold in check, prevent.
Hippe—billhook.
Hochbestand—high stand.
=*durchforstung*—high thinning, thinning of dominant trunks.
Hochwaldbetrieb—high forest system.
hochwertig—highly valuable.
Höhenentwicklung—height development.
=*rücken*—ridge.
Holz—wood.
=*art*—tree species.
=*bahn*—wood road.
=*bedarf*—demand for wood.
=*bestand*—standing crop, tree stand.
=*ertrag*—wood yield.
=*gewächs*—wood growth.
=*masse*—wood volume.
=*nutzung*—wood yield.
=*riese*—wood slide.
=*sortiment*—wood assortment.

H.—Continued.

Holzzucht—wood growing.
holzverarbeitend—wood-working.
Hornast—horny knot.
horstweise—groupwise.
Hügelpflanzung—mound planting.
humifiziert—humified.
humos—humous.
Humusschicht—layer of humus.
Hürdengattern—rails (fence), railings.

J.

Jahresring—annual ring.
Jäten—weeding.
Joch—length of rail.
Johanniskraut—St. John's wort.

K.

Käfer—beetle.
Kahlabtrieb—clear-cutting.
=*fläche*—cleared area.
=*frass*—an eating bare.
=*schlag*—clear-felling.
Kalkboden—calcareous soil.
=*milch*—milk of lime.
Kamp—enclosure.
Karabiden—Carabidae.
Keilspaten—wedge-spade.
Keimbett—germinating bed.
=*kraft*—germinating power.
=*ling*—young seedling.
=*probe*—test of germination.
=*ruhe*—arrest of germination.
keimfähig—fertile.
Keimung—germination.
Kerbe—notch.
Kern (roter)—heartwood.
Kernriss—heart-shake, heart-fissure.
=*wuchs*—seed-growth.
Kiefer—pine.
Kiefernbaumschwamm—pine-tree fungus.
=*eule*—pine owlet-moth.
=*markkäfer*—pine beetle.
=*reisig*—pine brushwood.

K.—Continued.

Kiefernrüsselkäfer—pine weevil.
=*schüttepilz*—pine-needle-shedding fungus.
=*spanner*— pine looper moth.
=*spinner*—pine moth.
=*triebwickler*—pine-shoot tortrix.
Kienzopf—top of foxy tree.
Kiesdecke—gravel surface.
Klapppflanzung—cleft planting.
Klause—lock.
Kleinpflanze—small plant.
Klenganstalt—coning establishment.
Klima—climate.
klimatisch—climatic.
Kloben—split billet.
Knochenmehl—ground bone, bone dust.
Knollenbildung—formation of knobs (tubercles.)
Knüppel—round billet.
konsolenförmig—bracket-shaped.
köpfen—to pollard, to top.
Kopfholzbetrieb—pollarding.
Kraftmaschine—power machine.
kränkelnd—sickly.
Krebs—canker.
rone—crown.
Kronenfeuer—crown-fire.
=*schirm*—leaf canopy.
=*schluss*—compact crown.
Krümelung—crumliness, coarseness (of soil).
Krummholzkiefer—mountain pine.
Kulturbetrieb—culture system.
=*fläche*—culture area.
=*methode*— method of culture.
=*weide*—cultivated willow.
Kümmern—starvation.
künstlich—artificially.
Kurzhacken—fine hoeing.

L.

Lage—location, position.
Landwirtschaft—agriculture.
Langholzflösserei—log rafting.
Langnutzholz—logs.
Längstrieb—leading shoot.
Lärche—*larch.*
Lärchenminiermotte—larch miner moth.
=*pilz*—larch fungus.

L.—Continued.

Larve—larva.
Lassreitel—standard.
Laubdach—leaf canopy.
=holz—broad-leaved tree.
Lauffeuer—running fire.
=käfer—ground beetle.
Läuterungshieb—cleaning.
Lawsonscypresse— Lawson's cypress.
lediglich—merely.
Lehmboden—loamy soil.
Leitergang—ladder, side gallery.
lichtbedürftig—light-demanding, intolerant.
Lichtbedürfnis—demand for light.
=einfall—light entrance.
=genuss—amount of light.
=schlag—light felling.
=standszuwachs—open stand increment.
Lichtung—heavy thinning.
Lichtungshieb—light felling, heavy thinning.
lichtstellen—to provide light, to interrupt the leaf canopy.
Lichtwuchsbetrieb—open stand system.
Linde—linden.
Löchersaat—sowing in holes.
=wirtschaft—group system of regeneration.
Lochpflanzung—planting in holes.
locker—loose.
Lockerung—loosening.
Lode—sprout, medium-sized transplant.
Lohlöffel—barking spoon, barking iron.
Lohporling—Polyporus Vaporarius.
Los—lot.
Loshieb—severance cutting.
=spülen—washing away.
Lottbaum—timber carriage, go-devil.
lückig—gaping.
lufttrocken—air-dry.
Lupine—lupine.

M.

Mächtigkeit—thickness.
Maikäfer—cockchafer, May-bug.
Mannbarkeit—ability to bear fruit.
männlich—staminate (blossoms).
Markstrahl—medullary ray.
Maserwuchs—curly growth.

M.—Continued.

Massenbruch—mass-break.
=*erzeugung*—volume production.
=*vermehrung*—increase in numbers.
=*zuwachs*—volume increment.
massgebend sein—be the measure (for).
Massregel—rule, measure.
Mast—mast.
Mäuseplage—mouse plague.
Meeresspiegel—sea level.
Meistgebot—highest bidding.
Mennig—red lead, minium.
Minderung—diminution.
Mischbestand—mixed stand.
=*holzarten*—mixed species.
Missbildung—defective formation.
Mitfruchtbau—simultaneous crop cultivation.
Mitteldurchmesser—mean diameter.
=*rippe*—midrib.
=*temperatur*—mean temperature.
=*wald*—coppice with standards.
Mollmaus—mould mouse, vole.
Moment—fact, force.
Moorerde—moor soil.
Mulde—depression.
Mure—landslide.

N.

Nachbesserung—later improvement.
=*hieb*—secondary felling.
=*lassen*—abatement.
=*teil*—residual part, superfluous part.
nachhaltig—in a sustained manner.
Nadelholz—conifer
Nagetier—rodent.
Nährstoff—nutritive material.
naturgemäss—natural, in accordance with nature.
Naturverjüngung—natural regeneration.
Nebenberuf—subsidiary occupation.
=*nutzung*—minor produce.

N.—Continued.

Neigungsgrad—degree of slope.
Nesterbruch—nest-break, clump-break.
Nichtderbholz—wood not included under "Derbholz."
Niederdurchforstung—low thinning, thinning suppressed trees.
=*schlagsmenge*—amount of precipitation.
Niederwaldbetrieb — coppice system.
Nonne—nun, nun-moth.
Notjahr—year of scarcity.
Nutzbarkeit—service, utility.
Nutzen—utility.
Nutzholz—timber.
nutzholztüchtig—of good timber.
Nutzrinde—timber bark.
=*wert*—yield value, utility value.

O.

Obenaufpflanzung—planting above surface.
Oberförsterei—forest district.
=*holz*—overwood.
=*ständer*—standard (reserved) tree.
Ochsenblut—ox-blood.
Odung—waste, barren land.
Orkan—hurricane.
örtlich—local.
ortsangesessen—local.
Ortstein—hardpan.

P.

Pachtertrag—lease.
Pappel—poplar.
=*plantage*—poplar plantation.
Peitschen—whipping.
Pflanzenabfall—plant offal, vegetable remains.
Pflanzgarten—nursery.
=*holz*—planting peg.
=*kamp*—transplant nursery.
Pflasterstrasse—paved road.
Pilz—mushroom, fungus.

P.—Continued

Pilzerkrankung—fungus disease.
Planieren—leveling.
planmässig—systematic.
Plänterbetrieb—selection system.
=*wald*—selection wood.
Plattensaat—spot sowing.
Platz—square.
Polyporusart—species of Polyporus.
Preisselbeere—red whortleberry.
Presstorf—pressed peat.
Prozentsatz—percentage growth.
Prügel—round billet.
Puppenräuber—ground beetle, (pupa robber).

Q.

Quadratverband—planting in squares.
Quebrachoholz—quebracho wood.
Quellen—swelling.
Querschnitt—cross section.

R.

Rabattenpflanzung—sowing on ridges.
Rabattierung—bordering.
Raff=und Leseholz—fallen dead wood.
Rajolen—trench plowing.
Rajolstreif—trench strip.
Randbesamung—border seeding.
raschwüchsig—rapidly growing.
Raschwüchsigkeit—rapidity of growth.
Raubfliege—fly of prey.
=*insekt*—insect of prey.
=*wirtschaft*—robber management.
Raummeter—stacked cubic measure, stacks.
Räumung—removal.
Raupenleim—insect paste.
Rebpfahl—vine pole.
Rechstreu—litter of dead leaves or needles.

R.—Continued.

Rechtsanspruch—legal claim.
Regenguss—heavy downpour.
Rehstand—deer stock.
=*wild*—roe deer.
Reife—maturity.
Reihe—row.
Reihenverband—planting in rows.
rein—pure, unmixed.
Reinigungshieb—cleaning cutting.
Reisig—brushwood, faggot wood.
Rentabilität—rentability.
Revier—district.
Riesen—sliding.
Riesweg—slide.
Rille—rill.
Rillendrücker—rill-board.
=*zieher*—rill-marker.
Rinde—bark.
Rindenbrand—bark burning.
=*gewebe*—bark tissue.
Rindviehmist—cow dung.
Ringschäle—ring shake.
Rinne—gutter.
roden—clear.
Rodung—clearing.
Roggen—rye.
Rohsortiment—rough assortment.
Rotbuche—redbeech.
=*erle*—red alder.
=*fäule*—red rot.
=*wild*—red deer.
Rötelmaus—bank vole.
Rotte—gang, band.
rücken—transport, remove.
Rückerlohn—transportation wage.
Ruckwagen—sledge.
Rückweg—slideway.
Rundholz—log.
Rüsselkäfer—weevil.
Rütteln—shaking.

S.

Saat—sowing.
=*kamp*—seed nursery.
Säelatte—sowing lath.
Saftzeit—sap time.
=*zersetzung*— decomposition of sap.
Sägmühlenbetrieb—saw mill practice.
Sähorn—sowing horn.
=*maschine*—sowing machine.
Samen—seed.
=*beschaffung*— procuring seed.
=*ertragsfähigkeit*—ability to bear seed.

Samenhandlung—seed establishment.
=*schlag*—seeding felling.
Sämerei—seeds.
Sandboden—sandy soil.
Särücksack—sowing sack for the back.
Saumschlag—strip felling.
Schaft—bole, trunk.
schälen—peel.
schattenertragend—shade enduring, tolerant.
Schattengitter—shade screen.
=*holz*—tolerant tree.
Scheide—sheath.
Scheiter—split billet.
Schichtnutzholz—stacked timber.
Schienenweg—railway.
Schilf—reed.
Schirmbestand—shelter wood.
=*schlag*—shelter wood felling.
schirmförmig—umbrella-shaped.
=*frei*—free of canopy.
Schlag—felling area.
=*fläche*—cut-over area.
=*führung*—arrangement of fellings.
Schlagruhe—period of rest from cutting.
Schleifholz—pulp wood.
=*weg*—road slide, slideway.
Schlittweg—sled road.
Schlucht—ravine, gully.
Schlupfwespe—ichneumon fly.
schmalspurig—narrow gauge.
schmarotzend—parasitic.
Schmarotzer—parasite.
schnabelförmig—beak-shaped, rostrate.
Schneebruch—snow-break.
=*druckgefahr*— danger of snow pressure.
Schneidelstreu—litter from lopping.
Schneisennetz—network of lanes.
Schnittprobe—cutting test.
Schönheitswaldung—beauty forest.
Schonung—closed wood.
Schule—transplant nursery.
Schulkamp—transplant nursery.
Schuppen—spade.
Schutzbedürfnis—demand for shelter.
=*streifen*—protective strip.
=*waldung*— protective forest.
Schwarzerle—black alder.
=*wild*—wild boar.
Schweinedünger—swine dung.
=*eintrieb*—pannage.
=*mast*—swine mast.
Schwerpunkt—important point.

Schwinden—shrinking.
Senkholz—sunken wood.
Setzreis—cutting.
=*stange*—slip.
Sickergraben—lateral trench.
Sitchafichte—Sitka spruce.
Sonnenbestrahlung—sunlight.
Spaltbarkeit—cleavability, fissibility.
=*pflanzung*—notch planting.
Spannkette—drag-chain, trigger.
spätblühend—late-blooming.
Spaten—spade.
Specktorf—rich peat.
sperrig—with wide-spreading branches.
Spiegelrinde—silver bark.
Sprengmast—quarter mast.
=*schraube*—blasting screw.
Spriegelzaun—tilt fence.
sprungweise—abrupt.
Spurweite—gauge.
Staatsgewalt—executive power.
Stamm—stem, trunk.
=*abschnitt*—trunk section.
=*achse*—stem axis.
=*feuer*—trunk fire.
=*teil*—part of trunk.
Stand—stand.
=*ort*—locality.
Stange—pole, stem, stalk.
Stangenholzalter—age of pole wood.
=*ort*—pole wood, locality containing pole wood.
Starklode—large transplant.
Stauwerk—water-stowing works (locks, dams, etc.)
stechen—to spade.
Steckling—cutting.
Stecksaat—dibbling.
Steig—path.
Steinbahn—stone road.
stellenweise—in places, spotwise.
Sticktorf—spaded peat.
Stock—stump.
=*holz*—stump wood.
Stoff—material.
Stoss—stack.
Strafgesetzbuch—penal code.
Strauch—shrub.
=*weide*—shrubby willow.
=*werk*—brushwood.
Streichtorf—molded peat.
=*rippe*—wooden runner.
Streifen—strip.
=*saat*—strip sowing.
Streu—litter.
=*decke*—litter cover.
=*ertrag*—litter yield.
=*nutzung*—removal of litter.

S.—Continued.

Strychninweizen—strychnine wheat.
Stücklohn—piece wage.
 =*zahl*—number.
stufig—graduated, sturdy.
Stummel—snag, stump.
Stummeln—lopping.
Stummelpflanze—stump plant.
Stundung—delay granted in payments, respite, grace.
Stürzen—pitching.

T.

Tagwurzel—shallow root.
Taxe—rate, price.
Teer—tar, pitch.
 =*öl*—tar oil.
 =*schwelerei*—distillation of tar, production of tar from stumps.
Teeren—tarring.
Tenne—floor, barn-floor.
Terrain—ground, country.
Terrassieren—terracing.
Thomasschlacke—Thomas slag.
tiefgründig—deep (soil).
 =*rissig*—deep-fissured.
 =*wurzelnd*—deep-rooted.
Tiergattung—animal species.
tierisch—animal.
Tonboden—clay soil
Torf—turf, peat.
 =*brei*—peat pulp.
 =*mull*—peat mould.
 =*stich*—spading of peat.
Tränkung—saturation, absorption.
Tränkungsfähigkeit—power of absorption.
Traubenkirsche—bird cherry.
Trieb—shoot.
Triften—floating.
Triftweg—passage for cattle, grazing path.
Trockenfäule—dry rot.
 =*gewicht*—dry weight.
 =*torf*—dry turf.
Turnus—rotation.

U.

übererden—covering with earth.
=*halter*—reserved standard.
=*schwemmung*—flood.
=*sieben*—sieving over.
=*wallungsrand*—edge of wound.
Ulme—elm.
Umbruch—breaking up.
umgraben—dig up.
Umhacken—hoeing.
umklappen—flap over.
Umlichtung—opening out.
umschippen—shovel about.
umstechen—spade about.
Umtrieb—rotation.
Umtriebszeit—time of rotation.
Umwehrung—surrounding protection.
ungleichaltrig—uneven-aged.
Unkrautdecke—cover of weeds.
=*streu*—weed litter.
=*wuchs*—weed growth.
Unland—waste land.
Unterbau—under planting.
=*grundpflug*—subsoil plow.
=*holz*—underwood.
unverschult—untransplanted.
üppig—luxuriant.
Urbarmachung—cultivation.
Urwald—virgin wood.

V.

Vegetationsruhe—arrest of growth.
Verangerung—overgrowth of weeds.
Verarbeitung—working up.
Verband—arrangement.
Verbreitungsgebiet—region of distribution.
Verbuchung—entering into books, book-keeping.
Verdämmung—suppression.
Verdunstung—evaporation.
Verfahren—procedure, process.
Verfilzung—matting.
Verjüngung—regeneration.
Verkaufseinheit—selling unit.
verkittet—cemented.
Verkohlung—charcoaling, charring.
Verpflanzung—transplanting.
verpuppen—to change into a pupa.
verschulen—transplant.
Verschulungsbeet—transplant bed.

V.—Continued.

verschwindend—negligible.
Versteigerung—auction.
versuchsweise—experimentally.
Vertilgungsmassregel—measure for extermination.
Verunkrautung—overgrowth of weeds.
Verwendungsweise—manner of use.
Verwittern—decomposition.
Verwitterung—weathering.
Verwitterungsboden—disintegrated soil.
Verziehung—distortion.
Verzollung—paying (estimating) of customs.
Vogelbeere—mountain ash.
volkwirtschaftlich—economic.
Vollsaat—full sowing.
Vorarbeit—preliminary work.
Voraussetzung—presumption, condition.
Vorbereitungshieb—preparatory cutting.
Vorbeugungsmassregel—preventive measure.
Vorfruchtbau—preliminary crop cultivation.
Vornutzung—yield of thinnings.
Vorschrift—direction.
Vorsprung—projection, start.
vorwiegend—preponderating.
Vorwuchs—advance growth.
Vorwuchshorst—group advanced in growth.

W.

Wachsraum—growing space.
Wachstumsbedingung—condition of growth.
Wachstumsenergie—energy of growth.
Wadel—felling time.
Wald—wood.
=*anlage*—forest plantation.
=*bahn*—forest railway.
=*bau*—silviculture.
Waldbehandlung—forest treatment.
=*besitz*—forest property.
=*boden*—forest soil.
=*brand*—forest fire.
=*feldbau*—forest and field cultivation, combination of field crops with high forest.

Waldflora—forest flora.
=*grund*—forest soil.
=*hammer*—range hammer.
=*mantel*—shelter belt.
=*pflug*—forest plow.
=*rebe*—clematis.
=*teufel*—forest devil.
=*weide*—forest pasture.
waldtrocken—forest-dried.
Waldung—woodland.
Walnuss—walnut.
Wanderkamp—temporary nursery.
Wassergehalt—water content.
=*reservoir*—water reservoir.
=*wirtschaft*—water management.
Wegbauten—road construction.
=*planum*—road surface.
Wegenetz—network of roads.
Weichholz—soft wood.
Weide—pasture.
=*vieh*—cattle.
Weidenheger—willow culture.
=*hegerbetrieb*—willow culture.
=*korb*—willow basket.
=*röschen*—willow herb.
Weisserle—white alder.
=*esche*—white ash.
Weisstanne—silver fir.
=*tannenpilz*—silver fir fungus.
Welle—faggot.
Werfen—warping.
Werg—tow.
Werterzeugung—value production.
Weymuthskiefer—white pine.
widerrechtlich—illegal.
Widerstandsfähigkeit—power of resistance.
Wiesenanlage—meadow cultivation.
Wildbach—torrent.
=*garten*—game preserve.
=*park*—game park.
Wildlingspflanze—forest seedling plant.
Wimmerwuchs—wavy growth.
Windbruch—wind-break.
=*mantel*—wind-belt.
=*wurf*—wind-warping.
Wipfelbruch—top-break.
=*feuer*—top (crown) fire.
Wirbelwind—whirlwind.
wirtschaftlich—scientific, economic.
Wirtschaftswald—managed wood.
Wollappen—woolen cloth.
Wühlratte—vole, burrowing rat.

W.—Continued.

Wundhacken—hoeing up.
=*haltung*—keeping (the soil) in a turned-up condition.
=*pflügen*—plowing up.
Wurzel—root.
=*faser*—root fibril.
=*schwamm*—root fungus.
Wurzeltorf—rooty peat.
=*verbreitung*—root distribution.
=*vermögen*—rooting power.
wurzellos—rootless.
Wüste—waste land, desert.

Z.

zähe—tough.
zerfallen—decompose.
Zersetzung—decomposition.
Zersetzungserscheinung—decomposition phenomenon.
Ziehhacke—draw-hook.
Zirbelkiefer—Cembran pine.
Zopfdurchmesser—top diameter, smallest diameter.
Zuchtpflanze—cultivated plant.
Zufuhr—addition.
Zukunftsstamm—future trunk.
zuwachskräftig—vigorously growing.
Zwischennutzung—intermediate yield.
=*stufe*—intermediate stage (or step.)

Commonwealth of Pennsylvania

DEPARTMENT OF FORESTRY.

PROCEEDINGS OF THE FIRST CONVENTION OF PENNSYLVANIA FORESTERS,

HELD AT HARRISBURG, PA., MARCH 4, 5, 6, 1908.

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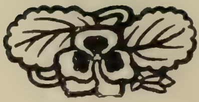

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THE PENNSYLVANIA DEPARTMENT OF FORESTRY.

THE STATE FORESTRY RESERVATION COMMISSION.

Robert S. Conklin, President.
Dr. J. T. Rothrock, Secretary.
Miss Mira L. Dock.
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THE OFFICE OF THE COMMISSIONER OF FORESTRY.

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Ralph E. Brock, Class of 1906, Forester.
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James E. McNeal, Class of 1907, Forester.
Paul H. Mulford, Class of 1907, Forester.
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Beginning with September, 1906, the first class of foresters from the State Forest Academy went into the field, and the second class followed September, 1907. For the purpose of comparing ideas and notes on their work and enabling them to have an interchange of thought, it was deemed advisable to bring them together during the early part of the following year for discussion of forestal topics and the reading of such papers on pertinent subjects as the men in the field might wish to present or hear discussed. Accordingly, on February 11th, 1908, the Commissioner of Forestry issued a call for the first convention of Pennsylvania foresters to meet at the Department in the new Capitol at Harrisburg on March 4th, 5th, and 6th, ensuing.

In the meantime, the wishes of the men were learned with respect to what subjects they wished to hear discussed, the program of exercises was prepared, and the meeting duly convened at the Department, Wednesday morning, March 4, 1908.

The Commissioner of Forestry presided at the meetings, and at intervals the other members of the State Forestry Reservation Commission, all of whom were present, were called upon to preside.

The papers presented by the young foresters are hereinafter contained and show that the men were interested in their work and desirous of learning whatever will assist them to bring better results. The discussions after the reading of each paper were participated in freely by all present.

The regular meeting of the Commission was held on Friday morning, March 6th, at which the foresters were present and saw how the business of the Department is conducted. During the sessions, at the invitation of the Governor, a visit was paid to the Executive Department where Governor Stuart in a short address welcomed the foresters and gave them some good advice with respect to their conduct both as men and officials. The Convention adjourned finally on Friday, March 6th, and the feeling of those who participated was that it was not only a successful meeting, but that much valuable instruction had been imparted which would be of permanent use to them in the forestal work of the future.

THE IMPORTANCE OF SURVEYS.

JOHN E. AVERY, *Forester.*

Surveying is the art of making such measurements as will determine the positions of points on the surface of the earth, so that a map of any portion of that surface may be drawn and its contents calculated. A survey of all forest lands or reserves of this Commonwealth is exceedingly important. Most of the State's reserve lines have not been run or retraced for years. Often the blazed trees have been cut, or have been destroyed by fire, or blown down. It takes a good surveyor with an instrument to follow them. Therefore, the lines should be run or retraced, plainly blazed, and blazes painted. Corners should be distinctly marked. The lines could be made more visible by cutting an open path and by posting notices at frequent intervals. This would show conclusively the lands of the State to all persons. The neighbor who intentionally or unintentionally gets over the line a little, and very often quite a distance, taking timber that does not belong to him, will not take the chance of crossing a well marked or well established line. Therefore, stealing of timber ceases almost immediately. There are but few cases of timber stealing on the reserves where lines have been retraced and visibly marked.

What can the wardens do, not knowing the lines? Absolutely nothing. They cannot properly patrol the land, and they are not sure of alleged trespassers being on State lands. One of the wardens reported to me several weeks ago that a party was chopping wood either on the reserve or very close to the line, but he was not sure and did not know what to do. He had asked this person where the line is and he could not show him, but said he was on his own land. In such a case, what are we to do? Finally we got a man living in the same community, one who claimed to know almost every line in the woods, to go with us. He put us on a line which had been run years ago and which he said was the State land line. Are we to rely upon the judgment of such persons, and will not work of this kind leave a loop-hole for timber thieves to plunder from the State lands? In a community like the one I have just cited every person seems to be related to every other or else they are bosom friends. What one knows all know. If they once find out that we do not know or are not sure where our lines are, they will cut without the least hesitancy and think all the while they are taking what belongs to them; for in a wooded country, and I think especially in Pike county, there are many men who do not think it a crime to go on his neighbor's tract and relieve him of some of his timber. I know of a man who was not a native of the county being driven off his own land at the point of a gun by a timber thief. The owner knew he had land, but did not know the exact location until he had his lines run.

If the lines of the reserves were surveyed, blazed, and posted, it would not only be a benefit to the persons in charge, but also to the public and to the sportsmen. The sportsman or hunter, probably not accustomed to the distance travelled, may find himself crossing a State line, opened, blazed, and posted. He is safe to the extent that he is not trespassing on lands of an individual or lands owned by a hunting club, and is not liable to arrest and fine of ten dollars or ten days in prison for trespassing, and have his game taken away from him; but he does know that he is on a State Forest Reserve, free for all to hunt or fish, provided he complies with the rules of the Forest Reservation Commission.

If our reserves were surveyed and the boundary lines cut open, we could have the lands under a better system of patrol. The wardens could cover more of the reserve in one day than they can now in two. As most of the lines are at present they are delayed by tramping through underbrush. Again, the cut lines would serve as wagon roads for getting out timber in the future, or as fire lanes, along which back-fires could be set whenever a fire is headed toward the reserve. We would thus protect the reserve from its most deadly enemy, and save hundreds of dollars for the Commonwealth.

From a forester's point of view, he cannot make a forest working plan until he knows what he has. Here again a survey is very necessary. Not only the outside lines should be run, but township roads, railroads, creeks, bluffs, and other obstacles should be located. Lines between localities having different jurisdiction, as county and township boundaries, interior tracts, lands upon which any rights are reserved, or any individual property, should be accurately located. The forester cannot divide his reserve into compartments which should have natural boundaries, as streams, crests of ridges, swamps, and valleys, because they are permanent, until he has a topographical survey which will show the various undulations and inequalities on the reserve.

In conclusion, without a survey, the forester is continually handicapped, because

1st. The wardens are unable to do their duty for the simple reason that they are not positive as to location of lines and have to depend upon the honesty of neighbors.

2d. It is not fair to the public, as the State Forest Reserves are open for recreation purposes to the people of the Commonwealth.

3d. It is most important for a forester to have a map of his reserve. He can do scarcely anything without a map from which to make his calculations and working plans.

FERTILIZERS FOR RENEWING NURSERY SOILS.

RALPH E. BROCK, *Forester.*

In discussing the subject "The Best Method of Renewing Nursery Soil," I have endeavored to include the two methods most generally followed in best agricultural practice, that is, the one in which there is application of commercial or other fertilizers, and the other, green manuring. The latter is preferable for supplying essential plant foods, because of its cheapness, reliability, and mostly because it involves few or no experiments to determine the plant foods, or the amounts that are most needful.

But laying aside the methods of fertilizing, there is nothing that brings the soil up to "dot," so much as thorough tillage, bringing out the old adage from which we get the word manoeuvre or manure, "he who tills the soil, manures it." From this tillage or working of the soil, the texture is improved, and in heavy or clay soils its absorptive value is increased. Of course tillage alone will not suffice. Composting or fertilizing must be relied upon to aid. From this source we obtain the needed materials, nitrogen, potash, and phosphoric acid.

Supply of Nitrogen.

There are two ways of supplying this essential plant food to the soil, the one by the application of nitrates, and the other by the practice of green manures, the latter of which is preferable, especially if the soil is poor. Where the nursery is of sufficient size to keep a portion of it (one-fifth) unused, this method is very suitable. To restore this portion is to begin early in the spring, sowing Canada field pea, seeded deeply at the rate of two bushels and one-half per acre, giving the soil a top dressing of 300 pounds of acid phosphate and 120 pounds muriate of potash. This crop should be ploughed under during the latter part of June and the land sown in cow peas. Plow this under in September and then sow rye. Give the land now a top dressing of 350 pounds Thomas meal, 2,650 pounds slaked lime, and 900 pounds kainit. This method will give the area one year in good nitrogen catch crops, and will improve the texture of the soil considerably, making a loose soil more binding and retentive of moisture or a clayey soil more open, porous, and absorptive. Also, it would insure nitrogen for years to come, the soil being thoroughly inoculated and also possessing a supply of potash and phosphoric acid.

The Supply of Potash.

The most available supply of potash and the one from which the least trouble can be expected, is in the use of unleached hard wood ashes especially on a soil that is clayey and wet. I have found ashes alone a splendid fertilizer at Mont Alto. Professor Johnson suggests 30 pounds of freshly burned shell lime, 10 pounds of bone meal and 8 pounds kainit a good substitute for wood ashes. This formula is equal to 100 pounds of wood ashes. The ingredients can be bought at the rate of $4.40 per ton; hence, it is decidedly cheaper and has no weed seed.

Phosphoric Acid.

Bone-meal containing three per cent. nitrogen and twenty per cent. phosphoric acid, and kainit containing the same amount of phosphoric acid, besides many other valuable plant essentials in small amounts, are the two best sources of phosphoric acid to be had at a reasonable price.

Formulae for mixing fertilizers and composts are as follows:

Composts.

Substitute for wood ash equal to 100 pounds, 30 pounds freshly burnt shell lime, 10 pounds bone meal, and 5 pounds kainit.

Thomas-meal, 16 per cent. citrates, 350 lbs.
Slack lime, 2,650 lbs.
Cornallite, 900 lbs.
Mix well together with fine turf, scatter over ground in late fall or winter, and work well in early spring.

Two measures of well rotted wood, two measures of well rotted horse manure, one measure of liquid manure. Keep in covered place until used. Even quantities of chip dirt and well rotted dung well mixed, to which wood ashes and lime have been added. Keep two years.
Ground bone, 300 lbs.
Bone black super phos., 300 lbs. (Fall).
Muriate of potash, 400 lbs.
Nitrate of soda, 89 lbs. (Spring).

Von Schroeder's:
Kainit, 520 lbs.
Super phosphate, 60 lbs.
Whale Guano, 320 lbs.

A good reliable fertilizer for general purposes, is:
Mixture of 30 pounds hen manure, 10 pounds sawdust, 16 pounds acid phosphate, 8 pounds kainit.

This will carry about 1.25 per cent. nitrogen, 4.5 per cent. phosphoric acid, and 2 per cent. potash, which used at the rate of two tons per acre would furnish 50 pounds nitrogen, 185 pounds phosphoric acid, and 80 pounds potash.

Substitute for Barn Manure.

Dissolve one bushel salt in enough water to slack five or six bushels lime. The best method for preparing for composting is one bushel of this lime to one load of swamp muck, though three bushels to five loads is a very good manure. Mix well.

In laying up the heap let layers of muck and lime be thin so that decomposition will be more rapid and complete. Sprinkle salt water on the lime as heat goes up.

When lime cannot be obtained, use three or four bushels of unleached ashes to one cord muck. Turn in a month or six weeks.

Home-made Guano.

Save all fowl manure from sun and rain under cover. Spread a layer of dry swamp muck and dump fowl manure on top of it. Beat into a fine powder with back of spade, add hard wood ash and plaster paris to make following proportions:

Dried muck, 4 bushels.
Fowl manure, 2 bushels.
Ashes, 1 bushel.
Plaster paris, 1½ bushels. Mix well.

A little before planting moisten with water or liquid manure. Mix with soil when planting.

While home mixing of fertilizers is less expensive than prepared fertilizers, care must be exercised in the selection of the needed constituents for two reasons; first, when certain materials are mixed chemical changes take place in which a valuable material is lost, as when lime and barn-yard manure are mixed, ammonia is given off; and second, a change to a less available form occurs as, when lime and super phosphate are mixed, the phosphoric acid is rendered less soluble; also, when potash salts and Thomas meal are mixed the product is apt to cake and becomes hard to distribute evenly. For this reason a German expert lays down the rule that lime and sulphate of ammonia; lime and super phosphate, lime and Thomas slag; lime and barn-yard manure; lime and nitrogenous guano, should never be mixed. Nitrate of soda and Thomas meal; nitrate of soda and lime; potash salts and lime; and potash salts and Thomas meal, should never be mixed. Kainit and lime; and kainit and Thomas meal, should never be mixed unless used at once.

No seed should be sown until several weeks after fertilizers have been sown, and where kainit is to be used in mixture, that is, in connection with a highly nitrogenous product, all but the nitrogenous product should be sown the fall before. Concerning lime and nitrate of soda I add the following, especially concerning the nitrate of soda.

A tree is a slow growing plant and soluble salts, as nitrate of soda, leach away before they can be assimilated by the plant. Regarding lime, except as a mechanical ingredient in compost heaps, no conclusive results have been found, except in the case of three hard woods. Cherry, linden, and American elm appeared to be benefitted.

My experience has been that all conifers suffer from the use of lime. Even from the use of diluted Bordeaux mixture as a fungicide in the endeavor to check "damping off" the coniferous plant suffered.

BROADCAST SOWING vs. DRILL PLANTING.

RALPH E. BROCK, *Forester.*

In the raising of seedlings for commercial purposes, the idea of importance is to raise the greatest number of even sized, vigorous, and thrifty seedlings on the smallest possible area at the least expense.

Whether this can best be accomplished by sowing the seed broadcast or in drills, depends largely upon the character of the soil in the germinating beds, the moisture conditions of the locality surrounding, as influencing the amount of soil moisture in these beds, the species to be raised and the character of the location in which they are to be finally planted. Broadcast seeding is most practicable where the land has been under a system of thorough tillage for several years, in which weeds have been effectually subdued, the water table raised by successful cultivation, and where the drainage conditions are such that excessive moisture easily and quickly passes away. These conditions would most likely be found in soil that varies from a sand to a sandy loam, and where the surface water of the higher ground surrounding the nursery site is drained away from the beds naturally or artificialy. Drill planting is successful under a wider range of conditions, the four to six inch space between the drills renders weeding less difficult, permits cultivation at all times, and, in times of drought, where there is no adequate water system at hand, allows one to break the soil to facilitate capillary attraction of water from the sub-soil. Again, billets of wood may be laid between the rows of seedlings, in a measure, keeping down weeds, preserving moisture and lessening the quantity of leaves needed to cover the beds in the fall.

In beds that have been sown broadcast, the raising of even-sized seedlings excepting by chance is nearly impossible. The seedlings on the edges of the beds are larger, more vigorous and possess a more healthy color, than the dense masses near the centre of the beds. From broadcast sowing it is possible to secure a larger number of seedlings per bed, but the beds present an uneven appearance. The north and east ends of the bed have seedlings several times larger than those of the centre, and those on the south side are likely to be dwarfs and possess a less healthy color, though this may have been caused by exterior conditions. Where the seed had been sown in drills these conditions do not exist to such great degree.

It has been said that broadcast sowing chokes out weeds, but in this State our sowing season is in the latter part of April, after plant life has started. Even if we soak the seed, germination does not take place for three weeks. During this time the weeds have a good start, and from this time on a proportionately larger number of young seedlings are pulled out by weeding in broadcast sown beds than from those sown in drills. For this reason alone one would think that broadcast sowing would be inadvisable except in old beds where weeds have been greatly subdued. The cost of this method of sowing is so large as against drill sowing, except as above, that it would be inadvisable.

The cost of making a bed 100 feet by 4 feet averages one dollar, and the cost of the seed $14.40, making an initial cost of $15.40, not counting the cost of sowing and weeding. Ideally, allowing one seedling per square inch, this bed should give fifty-seven thousand six hundred seedlings, over half of which would be lost in weeding, and from damping off and other causes. In clayey soil after a heavy rain with bright sun following, the soil would bake and nothing could be done. If a drought should follow under these conditions, as it generally does, the soil could not be loosened artificially. In drill planting the baking of the soil can be remedied, and the initial cost of a bed 100 feet by 4 feet is seven dollars and forty cents. There would also be from fifteen to twenty thousand plants with a greater likelihood of surviving. For this illustration two dollars are allowed as the cost of white pine seed per pound, using one and eight-tenths pounds per hundred feet broadcast and eight-tenths of a pound in drills. Of course drill sowing will increase the bed surface needed, but not necessarily increase the cost of working the nursery. More beds could be weeded per day, the time gained could be applied to cultivation, and in the end labor would be saved, more thrifty and vigorous seedlings would be produced suitable for planting both in brush and cleared land, and be more satisfactory to the nurseryman who raises them.

FOREST PROTECTION.

WILLIAM L. BYERS, *Forester.*

In considering forest management, among the first things should be the establishment of an efficient protection from fire, insects, and atmospheric influences. The most important of these in our case is protection from fire. Any reason for an economic forest policy implies forest protection as the first step to be taken. The object of forestry would be defeated without protection. The planting and tending of forests are useless and a direct loss without protection. The management of a reserve will otherwise certainly prove a failure. It is possible to do lumbering on only a few portions of the different reserves at this time; but if these lands be protected from fire for a period of from twenty-five to forty years, we will then be able to cut a crop of timber from the greater portion of the reserves. The first protective measure should be the demarkation of the reserve boundaries. This survey should be done by competent surveyors. In this manner all disputes as to ownership of land will be settled. Without a survey some people will advance claims as owners of land, and thus have an excuse for trespass upon State forests. In the survey of land, nothing but stone corners should be made wherever possible, as they are not so easily destroyed as posts and trees.

The next step should be the making of a good system of roads, trails, and fire lanes, which should completely cover the reserve. They will furnish safe and effective places from which to fight fire, and they will also make the reserve accessible in case of fire. If it is possible, a good system of roads and trails should be made in preference to the making of fire lanes. Fire lanes should be made only where the grade is to heavy for a road and where it is necessary for one or the other to be used.

There should be an efficient force of rangers, about one for every 5,000 acres of land, and in some cases, one for 3,000 acres, and, during fire season, there should be appionted wherever it is found necessary an assistant ranger. These rangers should be trustworthy and not be appointed for political reasons. They should be required to learn their districts, all roads, trails, streams, and note any improvements that may be needed. They should patrol their districts thoroughly, and learn the needs and habits of the people who frequent their ranges. There should be a tower on every reserve, located on the highest point, from which may be had a view over most of the reserve.

During fire season there should be one man in this tower at all times. He should be provided with a good pair of field glasses, a complete map of the reserve, showing the roads and streams, and should also have telephone connection with the officer in charge of the reserve, or the nearest ranger. There should be placed on the reserve at different points, small tool houses or chests, fitted with a lock and keys, and each man empoyed on the reserve should have a key. These chests should contain shovels, rakes, picks, and one or two torches for use in back-firing. One of these outfits would not cost over ten dollars. They should be placed along roads, so as to be easily accessible in case of necessity.

With a private individual, forest protection is a question of profit and loss; but with the State, whose purpose in obtaining this land is to perpetuate the forest supplies and preserve the water supply of the State, it is its duty to protect, even if it does not pay. By affording protection, the land will bring the results for which it was bought. It pays to protect forested land in Germany, and there is no reason why it will not pay to do so in this country. Protection from fire would be greatly benefitted by having the law of June 12, 1907, P. L. 527, apply to all timber lands.

In case of attacks by insects, one way in which they may be stopped is by introducing into the forest insectivorous birds. Trap trees may also be resorted to. It is seldom that insects will attack healthy trees. Therefore, having a healthy stand of trees, is, in most cases, a protection against insects. Against atmospheric influences, a change of species will in some cases stop wind-falls. The attention of campers should be called to the loss that results from forest fires, often caused by carelessness. It is necessary to educate the people so that they will be more careful with the use of fire in the forest. The slashing of cut-over lands should be burned at a season of the year when there is no danger from fire being communicated to surrounding forests. In the planting of old fields, it would be well to leave an open strip around the planting area, to be kept free of all inflammable material as a protection to the young seedlings from fire. Seedling transplants should be carefully watched for any attack by insects. From November, 1903, until March, 1908, or a period of 52 months, the cost of protecting the Bedford county reserve, consisting of about 9,000 acres, outside of the regular ranger's salary, was $374.48, $7.20 per month, or $0.0096 per acre per year. This includes the opening of fire lanes, the repair of a road a distance of three miles, and the employing of an assistant ranger during several of the fire seasons, and a surveyor for a few days.

NECESSITY FOR ADVANCING IMPROVEMENT WORK.

ROBERT G. CONKLIN, *Forester.*

The lands which the State owns are commonly called forest lands, but this is a comprehensive term. These lands may be divided, according to the character of growth, into six types, as follows:

Type A. *Mature Growth Areas.* Lands on which there is a growth to maturity, which will only depreciate in value by being allowed to stand.

Type B. *Normally Stocked Areas.* These are the lands which contain an average stock of young growth, being neither greatly over-stocked nor greatly under-stocked. This does not mean that they contain a normal growing stock.

Type C. *Over-stocked Areas.* These are the lands on which there is a good young growth of various species, but which stands too thick for proper growth. There may be a few cases of lands which are over-stocked with old growth, but they are few.

Type D. *Under-stocked Areas.* These are the lands on which there are not sufficient trees to form a forest canopy to protect the soil. On these areas there is very often considerable young growth of little value.

Type E. *Barrens.* These are not lands entirely without growth, as the name might indicate, but are lands which contain nothing more valuable than scrub-oak or fire-cherry. Hundreds of acres of this type of land are to be found in all parts of the State, and Pike county has a large area.

Type F. *Open Fields.* This, perhaps, needs no explanation, as they are just what their name implies. They are found on almost all of the reserves, but not in large areas.

This classification is not intended to be taken as a standard, but is intended merely as a rough classification for the purpose of this paper.

To give here a lengthy picture of the conditions existing in many parts of the State where fire has followed the lumber man, and only the stumps are left, is not necessary. We have all seen them and know what they are. Likewise we are familiar with the other types of land as given above, so a picture of them is not necessary.

We are given the work of making something of these lands. What we make out of them depends on the success we have in keeping out fires, and the improvement work put upon them.

This improvement work is mainly directed toward the correction of bad conditions, as stated in the types above, and may be said to consist of three operations, improvement cuttings, thinnings, and plantation work.

There is a distinction to be made between improvement cuttings and thinnings.

An improvement cutting is the first cutting made on a new area, with the purpose of bringing the growing stock as near the normal as possible, by removing dead, dying, and valueless species. *A thinning* is one of the cuttings made at regular intervals during a rotation, to reduce the growing stock to the normal. This distinction is used by the Federal Forest Service, and has been sanctioned by various authorities.

While our systems of protection embrace all of the lands we own, our improvement work is directed mainly towards the lands of types C and F, the over-stocked areas, and the open fields. In one case, on the Mont Alto Division of the South Mountain reserve, a tract which came under type A has been improved, but this is the only one of that class.

All of our lands demand more or less immediate attention, and I shall attempt to show why this attention should be given them; that is, show the necessity for advancing improvement work on the reserves.

First, we will consider it from the point of silvicultural reason. This reason applies more closely to lands of the over-stocked type than to any of the others. On these areas we find conditions which are the very reverse of good. The trees are crowded together, their boles are thin and spindly, and their crowns small and sparse.

Every quality of soil has a definite amount of nourishment available for plant use, and no more. Consequently when an area contains more trees than the soil contains nourishment to sustain, we find the conditions stated above. And this is what we find on lands of type C. There is insufficient nourishment for the stock, consequently the trees are retarded in their development and what growth there is, is generally of an inferior quality. These conditions are opposed to the best silvicultural development standards, and the longer they are allowed to remain so, the worse they will become. Now, go in there, remove the smaller and less valuable trees, and make available for the remaining stock the food which the removed trees used, and also the space for the spreading of their crowns. The remaining stock will advance rapidly, their crowns will spread out, and the diameter and height increment will increase. If enough trees are removed, the boles of the small spindly trees will increase more rapidly in diameter. If carrying out this improvement work means the advantages here stated, does not neglect of the work mean a corresponding loss? Every year the work is omitted means a year lost to the trees' development, and in the aggregate this is a great loss.

On the Mont Alto division of the South Mountain reserve, on the point of Pine Mountain, along the public road to the Consumptive Camp, there was made in the year 1904, an improvement cutting, covering a number of acres. The worthless and stunted trees were removed, cut into cord wood, and sold. Here we can see, in one phase, the silvicultural value of the work. Before this work was done there were a few white pine seedlings growing here. Their tops were of a sickly yellowish color, and the seedlings were not making their best growth. Since the cutting was made there is the greatest difference to be seen in these seedlings. Their tops are of a deep rich green, and they are growing very fast. And in addition, there are great numbers of all kinds of young seedlings coming on. These will soon fill the blanks left by the removal of the worthless and dead trees. To obtain the best returns and development on all these lands, they must be managed so as to bring the growing stock as near normal as may be done, and as soon as possible.

The economic and financial side of this question is somewhat closely allied with the silvicultural side, for on the attainment of the best silvicultural development depends the highest financial return. While the carrying on of this work now does not mean large financial return at the present time, there are economic reasons why it should be done at once.

One thing is sure: The carrying on of this work at present does not mean any increase in the cost of the work, but may mean a somewhat lower rate. The cutting and removal of small soft saplings is certainly cheaper than the removal of the larger harder poles, not only in the cutting but in the handling. Does not forest economy demand that work of this kind be done when it can be done with the least cost?

And then there is another phase. The removal of the stunted, diseased, and dying valueless trees means there is so much more nourishment available for the remaining trees. As stated above, this produces higher development both as to wood quality and quantity. Better development means greater financial return.

Take an area capable of producing two cords per acre per annum under the over-stocked conditions. The improvement of these lands will mean an increase of perhaps one cord per acre per year bringing the total up to three cords per acre per year. At the common rate for cord wood this means an increase in value of $2.00 per acre per year. Should this work be put off for 10 years, it would mean a loss of 10 cords per acre at a value of about $20.00 in the value of the woods. Will it not be better, financially, to do this work now when the cost is the lowest, and secure this increase in value?

Another economic reason for doing this work now is to prevent loss by reason of waste in the woods. This applies to two classes of lands, those on which there is no stock of any value or of very small value, and those on which there is a great quantity of timber, the removal of which is a help, both by benefitting the remainder and by a financial return.

Take those referred to first; which includes the open fields and the barrens. In the open fields and barrens we have a dead investment, *i. e.,* one which calls for expense, protection and taxes, but which produces no return. This is wasteful, but it cannot be remedied at once. In three counties, Adams, Franklin, and Huntingdon, we have taken steps to put these lands into the paying class. White pine and other seedlings have been planted on the open fields.

And again in the open fields we have another source of waste. On these places we encounter two great soil enemies, leaching and erosion. Rains beat down on the soil and what goes into the ground takes with it some of the soil fertility while that which runs off carries away the soil bodily. Trees are natural soil fixers and hence they are the things to use here.

So for every year these lands, the open fields and barrens, are left in their present state there is a loss through lack of return and payment of expenses, through loss of soil and soil fertility.

On hundreds of acres of State land, the ground is occupied by a mixture of valuable and valueless species. By the removal of the latter so much greater area will be available for the use of the former. On the Mont Alto Division on the top of the mountain, along the public road to the Sanatorium, there was a stand in which oaks of no value and aspen occupied much of the area. Under the direction of the forester, during the fall of 1904, these were removed, and now a good growth of oaks and chestnut is occupying the ground and filling the blanks.

As for the second mentioned lands, where the logs and tops are strewn around and dead and dying standing trees occupy the ground, the question has three phases. First, unless this stuff is utilized immediately it will be impossible to derive from it any revenue, for it will become rotten and worm eaten. Second, this stuff is occupying ground which should be supporting good young growth. Third, areas like this are fire traps. Fire starts easily here and once started burns fiercely, destroying everything in its path.

So improving areas like this will do three things; produce a definite financial return, give the young growth a chance, and destroy fire traps. On the Mont Alto division, Pondtown tract, there were 40 or 50 acres of dead poles. It had been a growth of oak and chestnut of 4 to 10 inches in diameter, but fire killed it all. This stuff was cut by the people of the vicinity, and hauled away. The Department received $0.50 per cord on the stump. Here the young sprouts are again taking hold and making a good start.

On lands of type A, where we have the mature and over-mature stuff, the question of the immediate advancement of this work hinges on the fact that these lands have ceased to increase in value by reason of any wood increment; but are either at a standstill or are going back. Just as soon as stock ceases to increase in value it is ripe for cutting, and where it has started to go back or depreciate in value it should be cut at once. Why not reap the crop while it will give us the highest returns, and give the second growth the advantage of that much start?

Again we have to go to the Mont Alto division for an example of this phase. On the Guilford tract near Pondtown there was a mature stand of oak and chestnut. Under the supervision of a forester this was cut off. It yielded the State about $1,400.00 clear profit. And here the sprouts are already starting, although this was cut over only during the spring and summer of 1907.

On the Caledonia division of the same reserve there are several stands which are about ready for cutting, and should be cut within the next few years. But so long as a stand is not really going back, it will perhaps be better to expend all our efforts upon those areas which are in greater need of improvement.

The financial side has this to be said in its favor, that by deriving a return from the lands we will be meeting the popular demand for some visible sign of what this business will amount to.

There is still another phase to this subject, which, while it may not appeal very strongly to the forester, has a decided hold on the minds of the people. This is the aesthetic value of the forests. One of the popular ideas of forestry is that we are working toward the creation and maintenance of forests as parks and outing places for the people. As we are to a greater or less extent working for the interests of the people, we should recognize this public demand so far as is compatible with the best interests of the forest.

When we come to look at the two extremes of forest land, and scrub oak barrens of Pike county or the stripped hillsides of Tioga county on one hand; and the cathedral pines of Mont Alto or the hard-wood grove on the road between Caledonia and the Sanatorium on the other, we will all agree that there is a great deal of good in the idea of developing the aesthetic beauty of the forests. There is a necessity at this time to get the work before the public. We must show that we are doing something real. Where will we find anything so likely to attract attention as the fact that an agency has been at work removing some of the eye-sores which exist along the public roads? A well regulated forest, without a tangle of old logs and greenbriars littering the floor, means more to the people than all the explanation about silvicultural development and economic use of the soil, and they will appreciate any effort we may make along this line.

Almost all of the operations so far carried out have been along the routes of public travel. Here the people see and appreciate the fact that something is being done. So with the necessity of getting the public's attention. Since the people will appreciate the development of natural beauty, do you not think this another reason for the advancement of improvement work?

And now will this work pay? There is an idea somewhat prevalent among the people that the real object of improvement work is the immediate return to be derived from the sale of material. That this idea is erroneous we all know. The real value of improvement work lies in the increased value of the remaining stock. In many cases improvement work can be made to pay for itself and in some cases to yield a profit. But where the need for advancing the work is great, it would be better to do it at a small immediate loss than to neglect it and lose the increase in value of the stock. As for plantation work it will more than pay for itself in the future.

Most of the states are taking up work in forestry, Pennsylvania perhaps in the lead. She has gone into it deeper and more business like than any of the others. There is still a lot of criticism and abuse by people who do not know anything of the subject.

On our work will depend the disarming of these critics and their change to friendliness. As before stated, most of the criticism is on the ground that there is nothing of any value resulting from the work. By advancing improvement work as rapidly as possible and showing by actual results that there is something being done, we will make and hold them friends.

While we all concede that improvement work is a necessity, we must not forget the need for another phase of the work, perhaps as important. I refer to protection. All improvement will count for nothing if we are to have it destroyed by fire. Every year thousands of acres are burned over. What will it benefit us if our work is to be obliterated within a year or two? While paying, therefore, all possible attention to the work of improving the lands, let us see that lands and work are properly protected.

A SYSTEM OF FOREST BOOK-KEEPING.

ROBERT G. CONKLIN, *Forester.*

In working out a system of book-keeping for a reserve, there is one thought to be kept constantly before you, simplicity. Where a forester has to do his own book-keeping, a complicated system will increase his work two-fold. Book-keeping will generally be done in the evenings after the day's reserve work is over, and a complicated system will needlessly increase his labors.

The conditions under which we must work are, perhaps, unlike any others where book-keeping is done. Each reserve is like a department in a big manufacturing concern, and yet different; for while a department of manufacturing has only one operation to deal with, here we have as many different operations as there are compartments or cutting areas in the reservation.

All our expenses are returned to a central office, and paid by moneys from there. Likewise all receipts go into the same office, but are paid from there into a different fund.

To work out a system of book-keeping which will be simple, yet applicable to the conditions under which we must work, will take time and experience. I am not an expert accountant, nor have I had an extensive experience in book-keeping. Consequently I do not set up any recommendations I may make as the best, but simply as recommendations.

In modern business practice, the card index system is rapidly taking an important part. Business forms of various kinds simplify matters, and system plays an important part.

On the Mont Alto division, there is in use a system of book-keeping which combines the use of books, blank forms, and cards under a somewhat elaborate system. This system of book-keeping is good and I thoroughly approve it, as it is clear and practical. There the conditions differ very much from the conditions on the reserves generally, for there are school accounts and reserve accounts which intermingle somewhat. But it is too complicated and elaborate for use on a reserve where conditions are simpler and the forester has to do his own book-keeping.

At Mont Alto they use the day-book, cash book, and ledger; a card index system, and a system of time-sheets and reports. The system of time-sheets and reports is good, and as it is, perhaps, as simple and effective as could be devised, it will be suitable for use on all reserves; but as for the books and cards, I believe them too cumbrous and require too much work to be valuable on reserves.

At the Asaph Nursery I tried to devise a system, which, while simple, would fill all requirements. Of course, here conditions were much different from those found on a reserve, for we had only one operation to take care of. Other operations such as surveys and road work, were simply charged to the Department. Here only two books were used in connection with the system of time sheets, a journal and a ledger. In the journal everything was charged as used, except labor, which was entered only at the end of each week or the last day of the month. In the ledger the work was divided into such accounts as operation, protection, grounds and buildings, equipment, etc. The real stock account was headed "Pennsylvania Department of Forestry," and all goods and checks received were credited to this account. All expenditures made for outside reserve work, but paid from the nursery, were debited to this account. At the end of the season the inventories of equipment, protection, and seedlings, were debited to this account and the account balanced. This system is faulty without a doubt, but having had no previous experience and needing it immediately it was the best that could be evolved at the time.

When I submitted this question for the Convention I had not expected to be assigned it as a subject, but had expected to get some information from the Department as to their wishes in this matter. So far as I know there has never been any statement made to the foresters as to how they wanted the accounts kept. Are we to keep a simple record of expenses and receipts, and allow the profits and losses to be determined for each reserve as a whole, or by compartments, at the Department? Or are we to keep a more elaborate system of accounts so that we can determine at a glance whether the operations on each compartment, or on the reserve as a whole, are being carried on at a profit or a loss? So far, I have been going on the supposition that the second case is the one under which we are working.

There is one thing which should be kept in mind though, and that is that all operations, expenses, and receipts, for each compartment should be kept separate. Whether this will mean simply a separate account in the ledger or a separate ledger for each compartment, depends on the viewpoint. Suppose we use one ledger. In this ledger each compartment or operation should have a separate account, and different accounts such as pole wood, lumber, shingle wood, etc., should be kept.

The use of a loose leaf ledger will, perhaps, be better than this for at the end of each year the leaves of the various compartments could be separated and filed, each under its own head.

By keeping these separate accounts or books, each compartment will be made a separate investment.

But this is, perhaps, too elaborate, for it will require that each compartment have its own rangers; that the forester and his assistant will have to keep record of their time so as to charge it to the compartments they have worked on; and that will mean perhaps too many accounts.*

I believe the best way would be to have someone whose business it is to solve such problems work out a simple but comprehensive system of book-keeping for reserve use.

I do have a few recommendations to make:

First: Let the system be as simple and comprehensive as possible. Nothing causes so much trouble and worry as mistakes in book-keeping, due to ignorance of the system used.

Second: Use wherever possible blank forms which indicate clearly what is required.

Third: Keep the accounts of each range or compartment separate, so that a glance will suffice to show whether the operations have been carried on at a loss or gain.

Fourth: Keep separate accounts, if possible, for the various classes of products.

Fifth: Keep a general account which will show the status of the business of the entire reserve at once.

There is still another point which I wish to place before this convention, and that is the value of an accurate and minute record of the daily progress of the work on each reserve. The use of a separate record book for each compartment would very likely be much better, but perhaps it would entail too much work. The best way may be to use what may be called a Year Book. Each book would be divided into the same number of parts as there are compartments in the reserve and the complete record of the operations on the compartments entered in the part of the book allotted to it. By the use of a separate leaf book waste in paper could be eliminated, and the sheets used could be removed from the cover at the end of the year and filed under their proper head. This would not only be cheap but would reduce bulkiness in the record.

But whatever is done, one thing must be remembered: A full and complete record of all transactions both in book-keeping and records, should be kept on each reserve. The sooner a practical system is worked out and put into use, the better it will be for all parties and interests concerned.

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*At present the conditions on each reserve differ from those on every other. With the instruction in forest book-keeping received at the Academy, each forester is expected to keep the best accounts under the circumstances, determining for himself largely what are his needs. After work on new reserves has been reduced to a system, uniform accounts will be required.

Commissioner of Forestry.

FOREST NURSERIES AND NURSERY WORK.

W. H. KRAFT, *Forester.*

The ever increasing demand for desirable timber trees brings to our mind the mission of Forest Nurseries, which is to supply seedlings of the most desirable species, in large quantities, at a nominal cost, to be used in reforesting waste and burned over lands.

These forest nurseries are being established by individuals, railroad, and lumber companies, state and national governments, for their own use, and professional nurseymen for the sale of desirable seedlings of the timber species for forest planting. This method is used to overcome the uncertain and slow natural regeneration of our most desirable species of timber trees.

The forest nurseries I will deal with mostly are the ones now established and operated under the direction of the Pennsylvania Forest Reservation Commission.

These nurseries, of which there are three principal ones at the present time are so situated in different parts of the State, that seedlings from them may be supplied to the different reserves without long or expensive shipment.

The one situated at Mont Alto, Franklin county, was established in the spring of 1902, and with which most of you are familiar from our forestry reports. One is situate at Greenwood, Huntingdon county, established in the fall of 1906. The other is situate near Asaph, Tioga county, established in the spring of 1907. Of the nursery at Greenwood, of which I now have charge, I wish to state as follows:

This nursery contains about two and one-half acres, is situate on a northwest slope in an old field, which was under cultivation for farm crops until the nursery was established thereon. The site is an ideal one for the raising of coniferous seedlings. The soil is of a shaly character and is protected on the west by a strip of woodland, which breaks the force of the prevailing westerly winds.

In the fall of 1906, Forester W. L. Byers, had this site plowed, manured, and cleared of stones. He also prepared the soil and planted in nursery rows two feet apart, one and one-half bushels of white oak acorns, one-quarter bushel of pignut hickory, one pound of black locust, which he gathered in the locality nearby. He also prepared twenty nine seed beds 4 x 70 feet, for the planting of white pine seed the following spring. In the spring of 1907, I was placed in charge of this nursery, but owing to the unfavorable weather and a late season I was unable to advance the work begun the fall before, until the last week in April. With what help that could be procured at that time, the seed beds were prepared and there were planted 75 lbs. of white pine in drills six inches apart, sowing a few beds broadcast as an experiment only; 5 lbs. Scotch pine, 5 lbs. European larch, 10 lbs. white ash, 3 lbs. cucumber, 40 lbs. shellbark hickory, 40 lbs. bitternut hickory, all sowed in drills six inches apart.

The seed beds are raised about four inches above the path, are 4 x 70 feet, and run east and west giving them the benefit of the shifting light throughout the day. All the seeds above mentioned were procured by the Commissioner from professional seedsmen, and were sent me too late to make test for germination. Owing to the ground remaining cold and damp until in June, the germination of all the seeds was retarded, none making any appearance until late in June and in July. The conifers showed almost a perfect germination, also the white ash. The cucumber was evidently worthless, as none of it germinated. The hickories were so badly ravished by the pine squirrels that very few were left to germinate. At the present time I am unable to give the exact number of seedlings in the nursery as no inventory was taken in the fall of 1907 owing to insufficient help. Taking an inventory in the fall requires another in the spring to account for loss by severe winter or heavy spring frosts. With proper appliances, such as screens to shade the beds, and an available water supply in case of drought for watering beds and seedlings, I think this nursery when fairly started will produce from five to eight hundred thousand seedlings a year. This will depend largely on the age of the seedling to be used in the planting operations, as more two year old seedlings can be procured than those transplanted. The age at which the seedlings may be used will depend largely on the location of the plantation; two year old seedlings being satisfactory for plantations in old fields and ground which are easily prepared for planting; but where there is a heavy growth of brush or briars, four year old transplants are more advisable. The additional cost of these transplants will be about $2.50 per thousand.

Other work done at Greenwood in connection with the nursery was the making of a black walnut plantation in an old field containing about four and one-half acres. This was planted in the fall of 1906 by Forester Byers, about 30 bushels of walnuts being used and planted four by four feet. The nuts were greatly destroyed by the squirrels during the winter. What seed germinated made a thrifty growth, in the fall of 1907 ranging from six to twelve inches in height. The blanks were filled in in the fall of 1907 with nuts, nineteen bushels being used for the purpose.

The year 1907 having been a fairly good white pine seed year, one hundred and fourteen bushels of white pine cones were gathered by boys of this locality, for which I paid thirty cents per bushel. While these cones when dried did not turn out as large a quantity of seed per bushel as some foresters estimate, from 114 bushels of cones I cleaned 77 lbs. of seed, ready for planting, averaging one pound of seed to not quite every bushel and a half of cones. Counting total cost of building screens on which to dry the cones, trays to catch the seed, and cost of cones, the price per pound was about $0.59. Allowing that these screens and trays will last five years instead of one, the cost would be reduced nearly one third.

The crop of other desirable seeds in this region, excepting walnuts, was a total failure in the year 1907.

The cost of labor in our nurseries and upon reserves could be reduced considerably, I think, if the question of hiring labor could be better adjusted than at present. Men are now employed only during the busy season of the year. This is unsatisfactory, as a man acquanted with the character of the work will do considerably more than one who is not. Therefore, steady, industrious men, who are quick to learn the work, are unwilling to be employed at a low wage for a few months only in the year. When men can obtain work at a higher wage even if it require their being away from home a great part of the time, they will seek such work. On account of the increased cost of living a man is unable to provide for a family on an average of eight months' work a year with 16 to 18 days per month, working only 145 to 150 days per year out of a possible 300 working days. Many of these men could be retained by giving them every possible day's work the weather permits. This could be done in opening necessary fire lanes, repairing roads, making improvement cuttings, and doing other work. Thus by employing a regular force, considerable more work could be done on the reserve with a smaller force than in the present way, and it would keep desirable labor in and about the reserve.

DIVIDING THE RESERVES.

LEWIS E. STALEY, *Forester.*

The subject of dividing the reserves into ranges, blocks, compartments, and sub-compartments is, without doubt, one which requires much forethought and a careful study of actual conditions found in the forest. Not alone must we be well acquainted with present conditions, but past conditions should be known in so far as they are of value in the future management of the area to be treated. If the reserves were to be divided into their several divisions at short intervals, say every five or ten years, the subject would be quite different; but since when once divided they are divided for all time excepting for small changes, we should have nothing short of a complete past and present record. A division of the forest depends largely upon the kind of management to which the reserve will be subjected: that is, do the conditions of the forest require an intensive management, or are they such that warrant only an extensive management?

These conditions can only be actually known by a complete survey. Until recently, the boundaries of lands owned by the Commonwealth were not well located. The method of this complete survey depends largely on the value of the forest as represented by the returns. Generally speaking, all main lines such as boundaries, all public roads, all streams, meadows, farms, and anything else that may be of a permanent nature should be surveyed and accurately marked. As these data, so procured, will form all skeleton maps for future management of the entire area, they should be carried out in the minutest detail and to the greatest degree of accuracy. Nothing should be left undone that might be of value in determining what lines to follow for the future.

Considering conditions as we have them on the reserves today, each reserve may be well divided under the following general heads, viz:

1st. Ranges,

2nd. Ranges into Blocks,

3rd. Blocks into Compartments,

4th. Compartments into sub-compartments.

By a range is understood such an area as may be conveniently covered by one man called a ranger. In the division of a reserve of twenty thousand acres or more there are two conditions which must be considered: The situation and the intensity of management.

In the case of scattered blocks, or in hilly country such as we have to deal with, the ranges may comprise a smaller area than if the blocks are consolidated or situate on level ground. In forests which yield a small return, as is the case with ours at present, the ranges may be large. Where the returns are large it pays to make the ranges small in order to facilitate a more intense management of the area. The boundaries of ranges should in all cases conform to some very conspicuous topographical features. If for some reason no well defined ridge can be had, some permanent fixture as a public road may be well suited to mark the boundary. In rare instances either of these may make the range too small or too large. Then the only method would be to designate the boundary by an opened line. It might happen that this line between the ranges may be well located for a fire lane and under these conditions would serve for both boundary line and fire protection.

Each range may again be divided into smaller divisions called blocks. These may or may not be of value other than reducing the area into workable sizes. If it should be convenient to divide the range into blocks by natural boundaries, very good; if not, it may be no detriment to the range. On large ranges this division into blocks may aid in designating any particular part of the range.

Again blocks are divided into compartments. Compartments are sometimes called the sylvicultural unit because they form the unit of work. The whole of this division is effected by using in addition to the outer boundary lines, interior natural lines, as creeks and smaller water courses; or some geographic unit, as a basin formed by two hills, the entire flat on top of a hill, or, in some cases, from the top of a hill to a ravine.

The boundaries of compartments may be made to coincide with the conditions of growth. For instance, a compartment may be composed of a pure stand of pine, of chestnut, or of some other species. Age conditions and, in some cases, public roads may conveniently form compartment boundaries; but it is best to have some geographical feature form boundaries when convenient. This will do away with the possibility of the lines ever being changed,—something that must be guarded against.

The size of the compartments as well as of other divisions depends on the intensity of management, the extent of danger from fire, and the size of the former division.

When there is necessity for dividing compartments these divisions are known as sub-compartments. Such sub-divisions should be avoided as much as possible because of the additional expense incurred in their management. When a compartment is composed of an area of large trees and an area of small trees each area may be called a sub-compartment, but as soon as there areas can be thrown together without much distinction of age classes it should be worked as one compartment.

Among the advantages to be gained by dividing the reserves are the following:

Each ranger knows exactly the area which he is to cover or patrol.

In case of operations a record can be kept and the exact location designated.

The best management can be effected by striving toward the ideal forest, and this is most easily accomplished by a systematic division of the forest into workable units.

A REGULARLY EMPLOYED LABOR FORCE.

LEWIS E. STALEY, *Forester.*

The necessity of a regular force of laborers is becoming more apparent as forestry advances. Not alone in forestry has this necessity manifested itself, but in all business operations one of the first things to be considered is men,—-a regular force of laborers—men that can be depended upon at all times.

How can good results be accomplished if the men that are doing the work are careless and unconcerned? If good results are to be accomplished in forestry as in any other business, the men must be more or less trained for the work they are to do. They must have practice, and this can only be obtained by having them employed regularly.

Some one may make the statement that men are plentiful, that men can be picked up at any time. Of course to a very great extent this is true at present, but is it not also true that such men as are available at any time of the year, are in many cases men that cannot be depended upon? You have them one day and the next day they are gone. They have some excuse, your work does not suit them, or perhaps the wages are too little.

Why does the State train its own foresters? It is simply because the Commission has found it to be the most advantageous way in which to fit men for the work. Men who are trained along certain lines can undoubtedly work to better advantage than those who may be picked up at any time. The same rule may be applied to laborers. They may not be so well adapted to the work in the beginning, but in most cases, woodsmen, in particular, can in short time do the work as it must be done.

A very good example of a regularly employed force of laborers is the section gang of a railroad. These companies have a certain amount of work which must be done just as the forester has on each reserve. Could not these railroad companies depend on picking up men as the occasion demanded? Is it not true that the "section" labor is almost at an end as soon as the rough weather sets in, and yet the majority of the gang are retained the entire year? There is something at all times to employ them if it is only to make a surplus of handles for their tools. The retaining of these men, in my opinion, is simply because the railroad companies have found it to be to their advantage to stick closely to their experienced workmen. The companies have so distributed their labor over the entire year that men are needed at all times.

The same idea with reference to distributing labor over the entire year could be used to advantage in forestry. While it is true there is certain forestry work, such as nursery work and fire patrol, which requires prompt action, there is a great deal of labor of other kinds which can be distributed over the greater part of the year just as it must be done when laborers cannot be had.

In forestry nearly every kind of labor must be done with the greatest care. Ordinary laborers in many cases are not capable of accomplishing the best results. For instance, take a man into the forest to do improvement work who has never swung an axe more than to split wood on his own wood pile; while he may be one of the best of workmen, he knows nothing about handling an axe, nothing about felling trees, cannot cut stumps as they should be cut, and in general knows little about the woods and the requirements of the work. But he is willing and always ready to do what is asked of him in his way of working. This man will soon realize how improvement work must be done, and in a short time can do fairly well. If men of this kind could be employed regularly, they undoubtedly would work to better advantage than if picked up at leisure.

Not alone in improvement work would a regularly employed force of laborers be a great advantage, but on reserves where nurseries have been established they could be available for the rush season of the year. In the early spring when nursery work must be pushed, when most planting must be done, and, as a rule when men are scarce, these regular men could be used to great advantage. By experience they would soon learn how nursery work must be done and in case of the absence of the forester in charge they could go ahead and cause no delay which so often is the case where the forester has charge of work other than that of the nursery.

Again in the spring and fall fire seasons there is always necessity for placing extra fire wardens on most of the reserves. The ranger in most cases has to patrol at least from five to seven thousand acres of mountainous country which, of course, is entirely too great. He may be in one region and fire be burning in another for several hours before he discovers it. Instead of taking some laborer not suited to the position, as in many cases the forester is compelled to do, one of these regular men could be available for each range at any time; and in case of rain or damp weather there is always plenty of other work for them, such as opening roads, fire lanes, repainting boundary lines, and numerous other small jobs that otherwise must be done.

The salary of these men would necessarily vary according to the standard of the locality. In localities where lumbering is carried on and where manufacturing establishments are near at hand a larger salary would be required. Under conditions as we have them on the Mont Alto reserve, $30.00 per month would be a reasonable salary to begin, with the chance of a raise as proficiency in the work is reached. These men would soon realize the importance of the work and once being interested they would undoubtedly work to the advantage of the State.

Next, the value of these men could hardly be estimated in case of fire. While this may not be true on the Mont Alto reserve where the Academy students are ready in a few minutes to respond to any fire call, yet on reserves other than this one, and where men are scarce, truly great results could be accomplished with these regular men. They would be ready at any time and cause no delay in getting to the fire, something that may aid in checking disastrous fires.

As a summary, where nurseries have been established on the reserves, the regularly employed force of men could greatly aid in getting the work through. After the rush season of nursery work they could be used to advantage in improvement cutting, thinnings, opening fire lanes and trails, and in any surveying that might be done; and last but not least they would be at all times ready for fire service which, in case of scarcity of men, would alone more than repay the salaries paid them by the State.

IMPROVEMENT OF THE RANGER SERVICE.

B. FRANK HEINTZLEMAN, *Forester.*

As the State forest reserves are placed in charge of foresters the more intense system under which they are managed demands that some improvements be made in the ranger service to aid in putting the system into effect. The ranger has an important part to perform in the management of the State reserves.

The first thing to discuss when considering improvements along this line is the duties of rangers. When a forester has charge of a large reserve, 20,000 or 25,000 acres, upon which much work has to be done, it is not possible for him to look after the details. He should plan and direct how it is to be done. The ranger should then be able to take charge of what does not require direct supervision of the forester, and carry it forward according to orders. Such work includes improvement cuttings, building roads, cutting fire lanes, burning brush, and the like.

For all work to be done on the respective ranges, they should under direction of the forester, employ the help needed and keep the time sheets. They should have the right to dispose of fire-killed timber in the way prescribed by the forester. Some rangers, especially those on reserves which are not yet supplied with foresters, seem to think that patroling is the one thing required of them; that if a certain amount of time is spent riding or walking over the reserve they have done their full duty. Instead of patroling being their whole duty it should be but a small part of it. The other part should consist in keeping roads in a passable condition, in opening the trails where necessary to make any part of the reserve accessible, in keeping springs well cleaned and paths opened leading to them, and in doing any other work directed by the Department.

The rangers should traverse that part of the reserve boundary along their ranges, at least once a month. Under the present method used by some rangers, of patroling only the roads nearest the lines, adjoining owners might cut over them for a long while and the rangers not be aware of it. Rangers should be encouraged to operate small nurseries in connection with their work and should be supplied with the necessary material for planting and instructions concerning the raising of seedlings. There are many half days when a ranger would otherwise be doing nothing that his time might profitably be spent in a nursery. The seedlings raised could be used to plant the many small blanks found in almost all forests.

All rangers should give their entire time to work on the reserves, and should not be engaged in an additional occupation, as farming or lumbering. No one can farm and care for a large area of forest land at the same time. He will either have to slight one or the other, and in most cases it will be the forest. Foresters should try to get their rangers interested in the work. Until the men are interested it will always be somewhat retarded and of a poor quality. Probably one of the best ways to arouse interest is for the forester to explain to them his plans of work for the coming month or the coming year. Explain why such work is necessary and ask their views concerning the manner of performing it. State to them the financial results of past operations. Men like to know what returns their labor is yielding.

The placing of rangers in charge of men employed on the reserves should help stimulate interest, for a man is always interested in a piece of work if he knows he is the one held responsible for the manner in which it is done. Copies of all reports, bulletins and circulars issued by the Department should be forwarded to them, so that they can gain a clear idea of exactly what the State is doing and wishes to do on its reserves.

At the present time some men hold positions as forest rangers who who are scarcely able to read and write. As long as the duties of rangers include only patroling and watching, these men do very well; but as the reserves are now beginning to be managed more intensely, a ranger should be a man of at least sufficient intelligence to be able to make reports on work done, to keep the time of laborers, and conduct the sale of wood.

Again, some of the present rangers are too old to be of much service to the Department. These men were often appointed when the land was purchased, no doubt because of their familiarity with the lines of the tracts. In this, it is true, they are often superior to younger men, but as the boundaries of the reserves are now being carefully located by surveys and men are being put in charge of the reserves who know how to determine the position of a line when the question arises, the need of their services in this direction is diminishing yearly. Because of their age they do not spend the amount of time on the reserves that they should, and they are not able to perform well severe labor, which often has to be done under trying conditions, such as fighting fire. Therefore, if the maximum age of men appointed was about 45 years, and then only those considered who are physically able to do hard labor, the reserves would show the result of the change in a short time. When a ranger is to be appointed, other conditions being equal, a man should be chosen who lives nearest to the reserve. One living three or four miles from his reserve cannot give good service with this distance to traverse to reach his work. If dwelling houses found on the reserves are to be used as houses for rangers and their families, they should be kept in repair. If it is necessary to erect buildings for this purpose, comfortable cabins should be built as the kind of men we like to occupy them is not the kind that is satisfied with anything.

All rangers should be sworn forest officers. When a man is under oath to see that the law is obeyed there is no inclination to leave wrongs unrighted. The ranger service might be greatly improved by the payment of a salary of about $45 per month, every man receiving the same amount. Very efficient men could be secured at such a salary. Even at the present salaries which as a rule are lower, some very capable men who are often making a great deal more than the rangers, figuring on a per day basis, inquire as to the prospects of getting a position, being attracted by the regular all-the-year-round employment. Much good might be accomplished by having the rangers make out their reports according to a regular system, showing the kind of work at which they were employed each day of the month, and the number of hours per day. The latter would prevent men from spending two or three hours on the reserve and recording it as the work of a full day. They should be allowed to be absent from the reserve a definite number of days per month. If they wish to be absent more days than the required number, the permission of the forester or of the Department ought first to be obtained.

A SYSTEM OF FOREST PROTECTION.

JAMES E. McNEAL, *Forester.*

Considering the short time which Forestry has been practiced in this State, and the condition of our land at present, the primary and most essential thing with which we have to deal is the protection of forests from damaging agencies.

Dr. J. T. Rothrock, in an article printed in the 1897 Report of the Division of Forestry, has written,—

"The one central point among existing conditions is that there is no use in attempting to save what forests we have, or to restore them upon ground from which they have been removed, until a reasonable protection against fire is assured. Neither the State nor the individual can hope for success until a thorough, radical change has been effected."

Fire protection, together with protection from other damaging agencies, precedes all benefits which we can receive, either directly or indirectly from our forests, and should be dealt with accordingly We should not only fight the danger after it has made its appearance, but should take measures for the prevention of all dangers to the forests. These dangers are numerous, and may, in a way, be divided into three classes:

1. Dangers from human agencies.
2. Dangers from organic agencies.
3. Dangers from inorganic agencies.

Under the first class, or dangers from human agencies, fire is certainly the greatest and most dreaded. Its source may be in so small a thing as a match, carelessly thrown aside by a smoker, but whose damage may be almost beyond computation, depending upon the condition of the weather, the efficiency of a protective system, or the nearness of a rain.

In calculating the amount of damage done by fire to forest land. usually only the destruction of good trees is taken into consideration, but indirectly the forest expectation value is seriously affected and the productive capacity of the soil lessened. Through the agency of fire the drain on our forests has been almost beyond belief, and although there have been large areas cut over, the amount of land burned over, in many places greatly exceeds it. This may be illustrated by a case in Oregon, where, during the past fifty years, there have been nearly 1,000,000 acres more land burned over than cut over.

Another case in which fire has done inestimable damage, occurred in New Brunswick in 1825, when there occurred what is known as the Miramichi fire, which, in nine hours, destroyed a belt of forest eighty miles long and twenty-five miles wide. More than 2,500,000 acres were burned over and nearly every living thing was swept from its path, 160 persons and nearly 1,000 head of stock perished. A number of towns were destroyed and 590 buildings burned.

Fires of this type are seemingly of the past, greatly due to laws and regulations governing the burning of brush, the awakening of the people to the importance and necessity of our forests, and the good work of Federal and State authorities. In our own State, statistics show a marked decrease in loss from forest fires. In 1902 the loss was $620,573, in 1903 it was $241,240, in 1904, $135,873, and in 1905 it was reduced to $63,951, which is less than 1-9 of the loss four years before. It does not follow, however, that the loss will decrease annually, and until there is a good system of protection established, we may look for very heavy losses.

The loss due to trespass is comparatively small and may be guarded against, to a great extent, by having good ranger service, by making all boundary lines conspicuous, and by placing warning notices through the tract.

Protection from organic agencies, i. e., from insect and fungus attacks, is very difficult and entails much study and experiment. The loss by reason of this agency is not nearly so great as that by reason of fire, but we must guard against it, nevertheless. This may be accomplished to some extent, by removing all breeding places, as dead or dying trees, and slashings.

Under dangers from inorganic origin we have "wind-falls" which, although they do not occur frequently, are often accompanied by very heavy losses. On September 30th, 1896, a destructive "wind-fall" occurred in Sullivan, Wyoming, and Luzerne counties, and although there is no exact estimate of the damage done, it is probable that not less than 200,000,000 feet were destroyed, covering an area of from 10,000 to 15,000 acres. This danger may be partly overcome by using proper methods of cutting, which should always be done under direction of a forester.

In establishing an effective system of forest protection it is necessary to do away with the cause of destruction. One of the most essential things is good fire and trespass laws. Penalties should be so severe that malicious people will be afraid to violate these laws, and careless people will be more careful.

It should be the duty of rangers, from the point of forest protection, to patrol the woods in order to guard against fire and trespassers, and to keep all fire lanes, or roads and trails used as fire lanes, free from inflammable material. They should have some knowledge of harmful insects and fungi, in order that attacks may be promptly reported to the proper authority and effective measures taken to check them.

During fire seasons, there should be men employed to patrol the woods, if there are not enough rangers to do it properly. There should be one man to not more than 5,000 acres. "Look-out" stations, with telephone connection when possible, should be built on points commanding a good view of the surrounding country. There should be a man stationed at each of these stations while there is danger of fire. With the aid of field glasses he would locate fires as nearly as possible, and report them so that men might be sent out promptly. If a system of telephone lines were established, one can readily see that help could be had soon after the fire started and in many cases could be controlled, with little damage. A system of telephone lines has been successfully operated in the state of Maine, and in 1904 reports from one telephone are said to have saved many thousands of dollars.

All lumbering contracts should obligate the careful burning of slashing, whether on state land or private land adjoining other forest land. Although lumbermen do not meet such demands favorably, on account of the expense, experiments show a very small cost. In pine regions the slash has been piled and burned at the rate of less than 25 cents per M. B. F. logs scaled, and in some cases it has been as low as 15 cents. In California experiments have been made in which the slashing was burned as the lumbermen left it, by burning small areas at a time, in a way that the fire can be controlled at all times. This has been done successfully and at a small cost.

Many advantages are derived from the burning of slashing, among which are clear ground for better reproduction, destruction of so-called "fire-traps," breeding places for insects and fungi, and easier means of travel through the woods.

There should be on all large tracts, a network of roads and trails in order to confine fires to areas as small as possible. When cutting fire lanes it is advisable to cut them in places where there are likely to be permanent roads in the future, which will be used as fire lanes. All fire lanes should be kept free from inflammable material and should be opened up annually, soon after the growth stops and before the fall fire season begins. When there are railroads through forest land there should be a strip burned on either side of the tracks and kept free from inflammable material during the time there is danger from fire.

Protection from trespass through ignorance may be established by cutting a clean and distinct path along all boundary lines. This path should be made conspicuous by marking line trees with a special blaze and posting warning notices. Warning notices should also be placed along frequently traveled roads and paths through the interior of the tract. All corners should be solidly built of stone which will not be greatly affected by the elements. In order that corners will be conspicuous they should be built of material which is not found in the immediate vicinity.

Although an effective system of forest protection will be expensive and will run into a good sized sum of money, it is better to establish it as soon as possible than to have losses, every year, that will in a comparatively short time exceed the cost of an adequate system of protection for many years. This may be illustrated by a case in the Adirondack Mountains where, in 1903, fires involving a loss of $3,500 entailed an additional expense of $175,000 for fire fighting alone. If this amount had been used in carrying out a system of protection during the dangerous months the great loss would have been averted, and protection afforded for many years.

MANAGEMENT OF FOREST LANDS UNDER PRESENT FOREST CONDITIONS.

JAMES E. McNEAL, *Forester.*

Under various circumstances a forest may yield its best return in wood, bark, or other forest products, in money, or interest on the capital which it represents, but which ever of these ways of using a forest is chosen in any given case, the fundamental idea of forestry is that of making the forest yield the best service possible at present and in such a way that its usefulness in the future will not be diminished, but rather increased. A forest well managed under practical methods will yield a return in at least one of the ways just mentioned; but before it will be in condition to render the best service, there are four things which a forest must have.

These are,—

1. Protection, especially against fire and thieves; for without such protection no investment is secure and the most skillful management is of little effect.
2. A strong and abundant reproduction. Without this a forest will speedily die out.
3. A regular supply of mature trees to be cut.
4. The proper amount of growing space for each tree, in order that all trees may grow to the best advantage.

The first requirement in the management of any property is that its condition be known and recorded. Hence, in placing a tract of forest land under management a survey is necessary. The object of such a survey is to have maps showing,

1. Outside boundaries.
2. Roads, rivers, railroads, and other means of transportation.
3. Lines between different localities having different laws, or which come under different jurisdiction, as county and township lines. Interior tracts of forest land, and land upon which any rights are reserved.
4. Contour lines and configuration.
5. Differences of soil. Whether agricultural, forest, or unproductive.
6. Fire lanes.
7. Cleared land within the tract.
8. Types of forest.
9. Any special land marks which may be noted.

In connection with these maps there should be a general description of forest, climatic, and surrounding conditions, of possible dangers, of market and labor conditions, and of means of transportation.

After this work has been done and one knows the condition of the forest, a division may be made into lots and aggregation of lots into ranges. In Pennsylvania, where most of the State forest land is in mountainous districts, division lines should follow the configuration of the soil. Difference of soil or character of growth within lots gives rise to sublots.

A valuation survey should then be made, ascertaining amounts of standing timber, rate of growth on various sites, and determining capability of production and future yield in material and money.

All these preparations should be made before a plan of management is determined. After one knows what can be expected from the forest, general plans should be made for all time, and special plans for a period of from ten to twenty years. The length of rotation should be determined and amounts to be cut should be designated, stating lots to be cut, with view of obtaining favorable distribution of age classes. Thinnings should be made, and methods determined to be used in felling and culture.

DISPOSAL OF FIRE-KILLED TIMBER.

PAUL H. MULFORD, *Forester.*

A fire running through a forest often assumes proportions that cause great damage to the roots of trees, burning the humus and ground floor, often burning the roots themselves, thus leaving the trees with few supports to withstand heavy winds. They are blown down and become a prey to fires which pass over that land again. Or the fire may burn away the bark of a tree, girdling it and leaving it standing a prey to injurious insects which are thus invited to and fostered in starting a breeding colony in these dying trees. Finally, finding no living tissue to feed upon, these insects go at once to the broken branch, or scarred trunk of a living tree, and proceed to start their work of destruction.

These two types of fire-killed trees we have to deal with largely on the reserves in this State. A method to dispose of them must be found. Standing or lying, they are a detriment to young growth, both by crowding and because of fire menace.

In the work of the U. S. Forest Service, it has been proved by many strength tests that fire-killed timber, for instance white pine, or fir, (Cir. No. 113, U. S. F. S.) is about twice as strong as green white fir; and that it is 9-10 as strong as kilndried timber where it has received the same treatment.

So there should be no hesitation in offering fire-killed timber as second-class lumber, and also as timber ready for preservative process. As the moisture has evaporated, there is no watery sap to act as a mechanical barrier to the entrance of the preservative. Green or unseasoned timber must be piled for several weeks before it is in proper condition for treatment, else it has to be subjected to several processes to season it artificially. Artificial seasoning is expensive and is liable to reduce the strength of the timber; therefore, sound fire-killed timber is really more valuable for preservative purposes than green. The dead timber being perfectly seasoned is more easily handled and cheaper to ship. Making the larger material salable for mining timbers, railroad ties, telephone poles, dimension stuff, and posts, which have a ready sale in our State, results in a double economy, the prevention of waste, and the saving of more valuable material for better uses.

The principal defect of fire-killed timber is check. This appears soon after the death of the tree, and apparently does not increase later. To prevent decay on the surface, fire-killed timber should be barked soon after it is killed. If the bark has been left on, the sapwood will be found somewhat decayed. Most of the conifers, and some hardwoods, will last a long time, if not lying flat on the ground.

In the west, especially in Colorado, where the mines of one city alone, Leadville, (Cir. No. 113, U. S. F. S) use each month 350 M.ft. B. M. of fire-killed timber for mine props, fire-killed timber is decidedly preferred to green timber because it is perfectly seasoned and light In Denver, fire-killed timber has been used for a number of years for boxes and crates with excellent results, being odorless and not liable to shrink or warp.

Pennsylvania with it many mines and factories using great quantities of mine timber, boxes, pails, and baskets, in their operation, should be impressed with the value of this class of material, and thus create a market for large quantities of fire-killed timber.

On a part of the Stone Reserve, an area of about 3½ acres, lie 25 M. ft. B. M. of fallen timber killed by fire. It stood for about two years only to be wind swept, and having no root system to hold it, fell. This is in a place six to eight miles from a railroad, and accessible only by a very poor trail road. One man made an offer to pay $1.00 per M. feet for all logs sawed mill measure, 50 cents per M. for shingles, 50 cents per M. for lath, and 30 cents per M. for fence posts. This prospective buyer says "that by taking all fire-killed and down timber, there is still left a good profit at these rates." Another, a boss logger, not wishing to make a bid says "$12.00 per M. can be safely paid for all the better stuff, and fire wood or charcoal be made of the inferior material."

Confining this subject to our own State, we must first realize that each reserve because of its geographical and geological position would be governed by its own peculiar conditions. The money consideration in the disposal of fire-killed timber in one case could hardly be used as an example for every other. However, having in mind the idea of advanced forestry, and the thought that fire-killed timber is a great detriment to growing trees, seedlings, and necessary undergrowth, as well as to the cause of forestry, its removal is warranted at an expense equal to its revenue. Personally, I believe that its removal is warranted at a cost in excess of its return value. Such a deficit is to be regarded a good investment on account of the improved conditions obtained in the then cleared and growing forest.

Again, with a careful system thoroughly thought out for each reserve and operated under good management, there will eventually be a return of revenue far above the expense, and plus this, give a clean forest, a practical object lesson in applied forestry, an opportunity to train unskilled labor, as well as create a force of local workers, breed a friendly instead of a hostile feeling to the cause of forestry, and last, but far from least, leave a general result that "He who runs may read."

Each reserve, with an idea of profit from fire-killed timber, must first cater to the need of its local market, and then create a market for the remainder of the product, the idea being to make the former bear the expense, and from the latter, the fragments, receive the clear gain or profits of the operation.

At my station, the Stone Reserve in Tioga county, from personal observation and information received from loggers, lumbermen, and local residents, it is believed the amount of fire-killed fallen timber warrants the erection of a model plant for the manufacture of lumber, boxwood, paving blocks, crate wood, lath, shingles, baled shavings and sawdust, poles, fence posts, stakes, fire logs, cordwood, wood distillation, charcoal, wood ashes for lye and compost, acid wood butts, and pulp wood. All of these could be marketed in a local or foreign market at a profit on the total production.

Having three streams of sufficient volume to generate electrical power to operate such a plant, also to supply power to operate a pumping and watering system for the five acre nursery of the reserve, the installation of such a system would not be amiss.

Certain kinds of fire-killed timber can be disposed of to local buyers, as in the cases already mentioned, and some cordwood could be sold to those making their homes nearby, and at no cost of labor or material to the Department; but such sales will be slowly made, and the period to exhaust the thousands of cords of stove wood and the many thousands board feet of lumber in log form will be long, after which the real cleaning up must be done by the State. Until this is done the reserve is open to fire, being practically without trails or fire lanes, at the present time. With a plant as mentioned, or any other of value, and an organized working force fully equipped, the question of the disposal of local fire-killed timber will be quickly solved, leaving a benefit in wages, a better sentiment toward forestry, and a lasting benefit in the impression of its advantages.

Thus briefly are outlined my ideas of the very important question of the "Disposal of Fire-Killed Timber," on the Stone Reserve, a matter on which I have had too little time to go into minute detail. After careful consideration it is believed each acre of State land having such timber, can be successfully handled, leaving to the State a money profit and an improved acreage for reforestation. Of the opportunity afforded by the danger of fire-killed timber to improve the ranger service, its relation to the question of roads, fire lanes, and trails, and a regularly employed labor force, cannot be entered upon at this time. That fire-killed timber has a bearing on all these matters is well understood by those who have given the subject consideration.

Finally, with a sales division of the Forestry Department organized to study and ascertain the needs of every portion of this State or nearby states, many or all of these products and by-products of the reserves could be disposed of to advantage with permanent benefit to the Department of Forestry.

ROADS, FIRELANES, AND TRAILS ON THE RESERVES.

JOHN L. WITHEROW, *Forester.*

Of all the branches of forestry, one that certainly deserves and requires our attention at present, is a system of forest roads, firelanes, and trails. Without these, forestry would be theoretical only.

A few reasons why:

1. They make reserves accessible and the removal of products possible.
2. They aid in the suppression of forest fires and insect depredations.
3. They may be made comparatively permanent.

A reserve road system should be laid out only after a careful study of the topography and market conditions of the reserve. It should not be built all at one time but rather developed gradually, and always fast enough to meet the demands of the increasing intensity of management.

An ideal road would be one which is perfectly level longitudinally, solid, smooth, and without curves, but we can only conceive of that just as we can an "Ideal Forest." In proportion to the number of these qualities that are lacking, so much less useful is that road.

The roads of a reserve should always be divided into two classes, main roads and minor roads.

Main roads should lead to the interior of the reserve and should be at least 16 feet wide, have a grade of five per cent. of less, and be made of stone.

Minor roads need not be so well built. They will connect main roads and also reach out from them into short valleys.

The old roads that we find on the reserve today were made for the purpose of removing forest products. On many of them travel was only one way, the empty wagons reaching the top by some other road much longer and less steep. On such roads the grade is so great that today they may be more properly called trails. They were laid out and built by men who knew little or nothing of engineering, but simply began and continued their work until their desired point was reached. Many of these roads are the best the locality would afford. Others should not be followed in our road building.

In all cases the route for a road should be surveyed in order to accomplish the best results from a given sum of money. Time spent on the survey must always mean both time and money saved on the construction of the road.

Not until a road is reduced to a five per cent. grade can it be called a good road, on account of the extra time and energy required for moving a load on it, and the great expense for maintenance.

It is the opinion of most men of authority, that the road that avoids the grade and is ten times longer, is the better road.

In laying out a road the survey should not be depended upon as the only guide. By every road the largest area possible should be made accessible.

Side drainage is as necessary, if not more so, on forest roads, as it is on roads running through cleared country, owing to the retentive nature of most forest soil. When building or repairing roads the camp should be moved as often as necessary to keep with the work. A working force of less than four men is unprofitable.

In our road building operations in Fulton county last year, we wanted a fair road up through a narrow valley seven miles long to serve both as a road and firelane in case of fire.

There was a road for three miles that was built over a hundred years ago for hauling out charcoal. We used it most of the distance except where grades could be avoided or the road straightened. A space seven feet wide was cut clear of everything on both sides for four miles. After this had been done, it was gone over, all rocks above the ground were removed, water turned off and holes filled up. This was done for $18.00 per mile for labor. After it was completed we could drive from one end to the other in fifty-five minutes.

There are perhaps no other branches of forestry, unless it be protection or survey, on which money spent at present, would give as quick returns or equal results as on forest roads, provided they are built in the proper places, and not at too great an expense.

To open up good roads from the interior of a reserve out to settled country, and where they are not needed, would be wasting money, beside being a temptation to trespass. After roads have been built it is comparatively easy to calculate the money saved by considering the difference in cost of marketing forest products, or it may be represented by an increased stumpage value. At present we are taking out about 500 railroad ties in Perry county at a profit of at least twenty-three cents on each. Had it not been for a road running to market, the timber probably would have rotted on the ground, the distance being so great as to prevent the building of a road at present.

No forest road should ever be made less than eight feet wide. A narrower road will admit of only one track and a narrow space at each side for the water to collect.

The transverse slope of a narrow road should be one-half inch to a foot. On a wide road of, say twenty feet, this may be increased for if water has to run a distance of ten feet with a fall of five inches it will run to the sides of the road very slowly. Steepness is the worst quality a road can have, as all other bad ones may result from it.

Water breaks are necessary on hills to turn off water. The should be made straight across the road, rather than diagonally, for when so made they are liable to break the couplings of heavy wagons.

It has been found by experience that stone roads built of three layers of stone of different sizes, prove most durable. The road bed should be level, solid, and free from roots and decayed wood. The largest stones are laid or thrown on it. On these a thin layer of smaller stones is put to fill up low places and to make it solid. The last layer should be fine dust and stones from a stone crusher. It should be of stones that contain cement such as lime stones. Such a road as this may be sprinkled and rolled or left for a year to settle before using.

A few facts worth remembering when building roads.

1. It is cheaper, quicker, and easier to remove large rocks by explosives than by hand.
2. Plenty of all kinds of tools, kept in good condition, lessens the cost of labor.
3. The laborers should never be left without instructions where to work. They will always find the wrong road.
4. A lazy man on the working crew is dear at any price.
5. Be boss yourself unless your advisors are more experienced.

All public roads on a reserve should be in charge of the Department of Forestry. The location of many of these will often be such that they should be main reserve roads. They cannot be so if township officers have the authority to repair them in any way they see fit.

Not until the annual two cent road tax is taken off forest reserves, and all the roads on the reserves built and maintained by the Department will it be satisfactory, to our side at least.

Firelanes.

Firelanes will serve only for the suppression of fires and diseases, and as boundaries of forest divisions.

They will likely always be necessary in Pennsylvania. The problems that interest us most are their cost, location, and width.

The expense of cutting firelanes will, in some cases, be reduced by the sale of the trees cut. Where old roads can be cut out and used for firelanes, the cost will be from $10.00 to $20.00 per mile. When made separate from roads they take up a large area from which no revenues can be had, and require frequent cleaning with money produced by the forest.

The width of firelanes will depend upon the species and its height through which the lane is cut, also the density of the stand and number of roads nearby. Their width in Pennsylvania will probably range from 10 to 25 feet.

Before laying out or cutting a system of firelanes on a reserve the general direction of winds should be noted, as the opening caused by some lanes may produce windfalls with certain species if the edge of the forest is directly exposed to the strong winds of the locality.

Sharp curves in narrow lanes will allow fire to cross. They should be avoided if possible.

For several years after being made they will have a tendency to grow shut. This they will lose as soon as the strength of the roots is exhausted. Firelanes should be of as uniform widths as possible and brush cut in the lane should not be piled up along the edges or pushed in between bushes, but should be thrown back over the brush, where it will decay sooner and not be blown back into the lane by every strong wind.

The entire boundary of all reserves should be a firelane of sufficient width to prevent fires from crossing. Reserve boundaries are often on the summit of mountains where growth is not dense or soil valuable for tree growth. These will allow lanes to be wider than elsewhere without any great loss of the working area of the reserve.

Most forest roads should also serve as a firelane by being cleared of all growth on each side, as far back as is necessary to make the whole opening of the proper width for a lane.

There are many reasons why firelanes should be made in connection with roads.

1. The expense for making and cleaning is less.
2. Floor space is saved allowing a larger working area which results in a higher normal yield.
3. The number of lanes that must be cut through the forest apart from roads will be fewer.
4. Travel will keep the road free from inflammable material.

Trails.

Trails may be necessary in many places on the reserve.

They should connect roads, or roads and streams, or may run from the nearest roads to fire towers. They take up little space and can be made and kept up at a small expense.

The loss that may be prevented by time saved on one trip over them in case of fire may be more than the original cost of such a trail.

They should be made sufficiently good to allow a horse to be led or ride quickly either way, or for water to be carried by a pack-saddle horse if they are in use on the reserve.

The only expense for maintenance will be for keeping off water.

Where a trail has been cut out in the middle by water, it usually retards travel so much that it is easier through the woods than on the trail. Their width and grade will vary as to their usefulness.

The necessity for roads, firelanes, and trails is so great that if they are neglected, Pennsylvania will fail to receive early revenues from her forests.

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December 1912

Commonwealth of Pennsylvania.

Department of Forestry.

FORESTER'S MANUAL.

PART I.

GENERAL INSTRUCTIONS
OUTLINE FOR ANNUAL REPORT
INSTRUCTIONS UPON FORMS

HARRISBURG:
C. E. AUGHINBAUGH, PRINTER TO THE STATE OF PENNSYLVANIA.
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GENERAL INSTRUCTIONS.

1. The business of the Department is increasing rapidly,and time must be saved in every possible way. Uniformity in terms used, in statements of expenses, and in various kinds of reports is absolutely necessary. Brevity and conciseness can best be obtained by tabulated data, and with this idea in view many of the forms have been evolved. Some have been taken almost without change from the records of forest management abroad, but in most cases time-tested forms have been used as the basis and such changes made as were necessary to make them of most value to the Department.

2. In many cases details will have to be given on separate sheets or on the back of forms dealing with the particular subject which needs to be set forth at greater length than is called for in the form itself.

3. The Department of Forestry uses a great many kinds of forms, a few of which do not concern the foresters or rangers in the field. Each forester should have a supply of all necessary forms on hand.

4. Each forester should be sure to place his name and the date in the right hand corner, at the top of each form or sheet used. No paper should be filed or sent from a forester's office without being dated and signed.

5. Careful attention should be given as to what each form is and to the instructions for using it. Many times the business of the Department is burdened or delayed by reason of the fact that forms must be returned with repeated instructions for correction.

6. Fill out proper report form as soon as each operation is finished and file it.

7. Use one form sheet for each operation, to be kept as part of reserve file. For report to Department in some cases one sheet may be used as a summary.

8. Keep a duplicate of each report.

9. Tabulate as much material as possible.

10. Always include cost of rangers' and foresters' time in the cost of any operation.

11. On forms upon which financial statements are made, as voucher, receipt, pay roll, etc., no erasures are permitted. If errors are made, new forms must be filled up.

12. The terms "miscellaneous items," "incidentals," and similar ones must not be used.

13. Neatness in all cases is required, and proper English is insisted upon.

14. The work in which the Department is engaged is for the benefit of the whole people of Pennsylvania. Money appropriated by the Legislature is taken from the people's money in the Treasury. Every citizen, therefore, has a direct interest in the work.

(a) Every forester must keep his records in such shape that he may be able, on a moment's notice, to turn to any item of operation or expense and give what information may be desired, either by an official of the State or by a citizen.

(b) All records and operations must be open to inspection.

15. Make notes as to improvement of forms or outline and submit the same with your annual report.

16. If in doubt concerning anything, write immediately to the Department for information and assistance.

17. Order all forms by number.

18. Forms have been made uniform as to size, either 8½ x 7 or 8½ x 14 inches.

(a) One fold is sufficient in the case of the small size.

(b) To fold the large size

1—When the heading is across the 8½ inch side, take the form at the bottom of the sheet in right hand and fold in half to the top, and then fold in half again in similar direction. Any backing may now be placed on the upper surface of the fold at the left end.

2—When the heading is across the 14 inch side, take the left edge of the form and fold over to the right, and then fold in half again in similar direction. A backing may now be placed upon the form, at the top, as it lies folded.

19. All report material not written on forms must be on paper of the same size as the forms, viz., 8½ x 14 inches, or on regulation typewriter size, viz., 8½ x 13 inches.

20. The following definitions shall prevail in the service:

(a) A reserve is a large contiguous tract of State land.

(b) A division is that portion of a reserve under the direction of a forester or assistant forester.

(c) A range is that portion of a division under the protection of a ranger.

(d) A block consists of a number of adjoining compartments, as for example, those within a certain watershed, or covering a certain mountain, and may be designated by the name of the stream, or mountain, or by some local historic name.

(e) A compartment shall be considered as the smallest unit of management.

1—The boundaries should be either natural features or roads and trails.

2—The area should not exceed 300 acres, and whereever possible should average much less. Uniformity in area is desirable.

(f) A sub-compartment is the area occupied by a growth of more or less even age, a pure stand, or an area exhibiting a distinct soil quality, etc.

1—A sub-compartment may be permanent or temporary.

2—There should be as few as possible.

OUTLINE FOR ANNUAL REPORT OF FORESTER.

The forester's report for each year must be submitted to the Department on or before January 10th of the succeeding year, and must conform to this outline. In the year preceding a legislative session a preliminary report must be submitted covering the main features of the outline, and must be in the Department by the 15th of November.

Deal with each item in the outline each year. Where desired information is lacking or does not exist, a statement to this effect must be made, e. g., if there have been no fires upon the reserves, say "No fires this year." When necessary, incorporate the material of the previous report. As the forester becomes more familiar with his reserve he will be able to change his statements to what is more nearly correct. As surveys progress, areas, ages, volumes, etc., will be definitely known.

1. Name of reserve, if named, and situation by counties; also subdivisions when definitely determined. See Form 37.

    (a) Each year should add something to the historic record of the reserve, and whenever items of interest are obtained records should be made at once. Historic record must be revised in report of years ending in 0.

    (b) A report of the following features is to be made at the end of the first full year that a forester has been on his reserve, and revised thereafter in years ending in 5.

        1—Geologic characteristics, naming group or groups of rocks showing on surface, character of soil, and whether surface is of glacial deposit.

        2—General topography of reserve, stating whether plateau, hilly, or mountainous, and naming approximately the proportion of each.

        3—Local climatic conditions.

2. Forest Staff:

    (a) Rangers.

    (b) Other regular employes.

    (c) Statements concerning them.

3. Status of boundary survey,—completed or not; condition of boundary line,—brushed, painted, and posted or not; statements or suggestions concerning the same; corners.

4. Interior or exterior tracts,—difficulties or advantages arising therefrom; tracts State should own and why; information of value relative to possible purchase.

5. Areas: (Tabulate and revise from year to year as the reserve is more familiarly known. Always give previous year's estimates and indicate any areas actually surveyed.) Submit whenever possible a map of the reserve showing these areas. See Forms 37, 38, 39.

    (a) Total area added by years; virgin forest, if any.

    (b) Area covered with mature or hypermature forests, and approximately the volume according to material it would produce; species, market conditions, and proposed meth-

ods of operations in detail, including methods of regeneration.
- (c) Area covered with stands having a density of 50 per cent. or over. Divide this area into two classes:
    - 1—Number of acres not in need of improvement.
    - 2—Number of acres in need of improvement.

  State approximately the amount of wood product which may be removed, noting form and species and possible present markets.

  State conditions under which operations may be made profitable.

  State what must be done to bring the stands to normal density.
- (d) Area with scattered trees from a density of 10 per cent. up to stands having a density of 50 per cent.; species, and amount of material which should be removed, market conditions, etc.

  State what must be done to bring the stands to normal density.
- (e) Area, not included in above, covered with brush or weed growth, as scrub oak, bracken, briars, huckleberry bushes, etc.

  State proportion of this area which will be naturally reforested by a growth of valuable species if protected from fire and grazing: Reforesting of remaining portion; amount of fire killed timber.
- (f) Area of open ground where seed or seedlings may be planted now with little or no difficulty, as old fields, mill sites, severely burned areas, etc.
- (g) Area covered with rocks, where no cutting ought to be done, or where no regeneration can be expected.
- (h) Area covered with water;—lakes, dams, ponds, and streams.
- (i) Area used for roads and trails.
- (j) Area used for fire lanes.
- (k) Summarize areas from above where reforesting by planting is not justified at present rate of cost.

6. Springs and Streams:
    - (a) Locate all springs on map.
    - (b) State whether springs are cleaned, made accessible, or posted (named).
    - (c) Data with reference to flow of springs. Continuous or not; unusual flow or drying up, and probable cause of same, whether due to climatic conditions, humus conditions, drainage, or other cause.
    - (d) Condition of streams generally.
        - 1—Regularity of flow.
        - 2—Contamination.
            - (a) Possibility.
            - (b) Prevention.
7. Buildings and repairs:
    - (a) Condition of all buildings on reserve.
    - (b) Need of repairs or new buildings.
    - (c) Fences.

- (d) Telephone lines existing on or near the reserve; service, expense, need of extension, etc.
- (e) Other conditions necessary for comfort and efficiency of personnel of the service.

8. Roads. See Form 36.
    - (a) Distinguish carefully between extension and improvement as indicated at head of form.
    - (b) Blasting, brushing, rebrushing, bridging, etc., should also be kept separately.
    - (c) Improvements should be specified on the reports and cost reported on a basis per 100 feet of total length, not simply upon the distance covered by the improvements.
    - (d) Outline of road system as planned to date, or map of the same. This can be made only after a careful consideration of markets and of configuration of reserve.
9. Easements:
    - (a) Rights of way.
        - 1—Conditions relating to all such rights.
        - 2—Good or bad features.
    - (b) Other easements.
        (An easement is a right to exercise a privilege adversely to the owner of the title.)
10. Leases:
    - (a) Revenues, and material removed.
    - (b) Benefits or detriments.
11. Minerals and other valuable products.
12. Seed Collection:
    - (a) Date.
    - (b) Species.
    - (c) Amount.
    - (d) Cost per unit of measure to time of planting or shipment.
    - (e) Quality.
    - (f) Amount to be used by self.
13. Plantations: See Forms 33, 34, 35.
    - (a) Date on each form should be the date on which plantation is made.
    - (b) Planting Summary (Form 34).
        - 1—Make separate statements of seeds planted in nursery and of those placed in plantations.
        - 2—Must correspond with the totals of plantation reports.
        - 3—Indicate with red ink, seed and plants collected, raised and planted on your own reserve.
    - (c) Measurement of past plantations must be revised and kept to date. See Form 35.
    - (d) Area (total) planted to date with seeds and with seedlings.
    - (e) Amount (total) of seeds and number of seedlings by species planted to date on reserve (not in nursery).
14. Nurseries:
    - (a) Date established and area at time of establishment.
    - (b) Area in current year.
    - (c) Inventory of seedlings by species and age.
    - (d) Number of seedlings available for spring planting, giving species, age, and cost per thousand.

(e) Number of seedlings shipped to individuals during year.
        1—To foresters or rangers for reserve planting, giving name, place to which shipped, number of each species according to age, and price per thousand.
        2—To private individuals, giving name, address, species, age, number, and price per thousand.
        3—Number used on own reserve.
(f) Amount of seed planted in nursery. See Form 34.
(g) Statements concerning temporary or permanent improvements and general nursery conditions and work.

15. Sample Plots, Experimental Plantations, etc.:
    (a) When established.
    (b) Name.
    (c) Location.
    (d) Area.
    (e) Object of development.
    (f) Measurements past and present. (Tabulate all data).
16. Labor Conditions:
    (a) Wages per day or per hour per man.
    (b) Wages per day or per hour for teams, with and without drivers, etc.
    (c) Reasons for high or low wages.
    (d) Scarcity and quality of labor, and cause for same.
17. Improvement Cuttings: See Forms 13, 31, 32.
    (a) Conditions existing previously.
    (b) Conditions subsequently and benefits expected.
    (c) Conditions of improvement cuttings of previous years.
18. Market Conditions:
    (a) Needs of the district.
        1—Specifications.
        2—Species.
        3—Quantities used per year.
        4—Prices.
    (b) Transportation facilities.
    (c) Railroad rates.
    (d) Possibilities with reference to the reserve in detail in accordance with present market conditions.
19. Data with reference to growth. See Forms 35, 39, 40, 41, 42.
20. Erosion.
21. Insect or fungus attacks.
22. Forest Fires: See Forms 17, 19, 49.
    (a) Statements not covered by forms.
    (b) Observatory stations.
    (c) Fire wardens and their work.
23. Trespass and fines:
    (a) Violations of forest, fish, and game laws, or reserve rules reported and disposition of cases.
24. Outing and Recreation:
    (a) Camps and campers.
        1—Number.
        2—Matter with reference to their conduct.
        3—Hunting:
            (a) Number of deer killed on or in the neighborhood of the reserve.

            (b) Other game.
        4—Fish and fishing.
    (b) List of camp sites by common name and location.
    (c) Other uses of reserve for outing and recreation.

25. Inventory: (Use separate sheets.)
    (a) All tools on reserve, condition, and value.
    (b) All other property belonging to Commonwealth:
        1—Books.
        2—Instruments.
        3—Stock.
        4—Implements.
        5—Other material not before enumerated.

26. Summary of Accounts of the year. See Forms 30, 31.

27. Summary of suggestions.

28. Budget for succeeding year:
    (a) Labor proposed and estimated expense in detail.
        1. Road Work:
            (a) New roads, Name Length.
            (b) Old roads to be repaired or brushed. Length.
            (c) New fire lanes Length
            (d) Old fire lanes to be brushed, miles
            (e) New trails to be cut.
            (f) Estimated cost of (a) $....................
            (g) Estimated cost of (b) $....................
            (h) Estimated cost of (c) $....................
            (i) Estimated cost of (d) $....................
            (j) Estimated cost of (e) $....................
            Total estimated cost, $....................
        2. Improvement Cuttings:
            (a) Estimated area to be improved, ...acres.
            (b) Estimated amount of material to be derived from improvement cutting.
            (c) Estimated value of product so obtained, $....................
            (d) Estimated cost of suggested improvement work, $...............
        3. Repairs to buildings:
            (a) Cost of such recommended repairs, $........
        4. Other suggested improvements:
            (a) Probable cost, $..............
    (b) Seeds and seedlings required:
        1. Seedlings needed for planting during the year.
            Species Quantity Spring or Fall.
        2. Estimated area in acres to be covered by the above planting.
        3. Quantity of tree seeds needed for planting in experimental plots or nurseries.
            Species Quantity
            (a) Estimated cost of planting, $..............
    (c) New or altered equipment.
        1. Estimated cost, $.................
    (d) Other items of expense.

INSTRUCTIONS UPON FORMS.

1 and 2.

Vouchers for expenses paid from appropriation to Department for contingent expenses. They are used only in the office of the Department.

3 and 4.

Vouchers for all Reserve Expenses.

1. Vouchers will be made up in the Department.

2. Statements for vouchers must be submitted in detail by letter, setting forth bill, by name and amount, as

Pay roll,	$150 67
John Jones,	11 00
John Smith,	6 77

3. Railroad fare must be indicated in this manner:

Jan. 14.	To railroad fare, Harrisburg to Summerville, P. R. R., 250 miles (mileage),	$5 00
	To railroad fare, Summerville to Clarion, P. S. & C. R. R., 16 miles (ticket),	65
16.	To railroad fare, Clarion to Summerville, P. S. & C. R. R., 16 miles (ticket),	65
	To railroad fare, Summerville to Harrisburg, P. R. R., 250 miles (mileage),	5 00
20.	To railroad fare, Harrisburg to Lebanon and return, P. & R. R. R. (ticket),	1 05

Mileage books should be used whenever possible.

No receipt need be taken.

Pullman fare checks will be accepted as receipts.

4. Trolley fare must be indicated:

Jan. 24.	Trolley fare, Mt. Pleasant to Greensburg,	$0 20

No receipt need be taken.

5. Livery or automobile hire should always be accounted for by receipt (Form 7) or by receipted bill on liveryman's bill head, the latter preferred.

The entry on the receipt or bill should be:

Horse and buggy, Muncy to Eagles Mere and return, 20 miles,	$3 00
Or, Double team, and driver, Milford, to Blooming Grove, 21 miles,	8 00
Or, Automobile, Renovo to Crossfork and return, 30 miles,	9 00

6. Express and freight charges must be accounted for by submitting receipts on the respective company's receipt form.

7. Telephone charges should be entered according to date and places between which the telephone was used.

8. Charges for single meals obtained at restaurants, or on dining cars enroute, must be noted as follows:

Jan. 14. To dinner enroute, P. R. R. diner 4447, ...	$0 90

No receipt need be taken.

9. Hotel charges should always be accounted for by receipt (Form 7) or receipted bill on hotel bill head.

10. Do not fail to itemize fully each expenditure for which no itemized receipt has been taken. The terms "incidentals," "miscellaneous," and the like, are not to be used.

11. In the case of surveys, hauling and boarding may be placed on pay roll (see Form 27) together with service. Separate receipts must be furnished for all other expenses incurred in the survey.

12. All expenses other than for traveling, those incident thereto, and for surveying, amounting to more than ten dollars require a separate voucher, in which case there must be submitted a receipted, itemized bill, on individual bill head, or on Form 7, which will be attached to a voucher with the following entry:

Jan. 17. To amount paid as per receipted bill attached hereto, ...	$15 85

The voucher must be signed by the individual furnishing the supplies.

13. Pay rolls, receipts and receipted bills of all kinds must be stamped "Received-Correct-Approved," and countersigned by the forester on the line provided for signature under the above words. This, of course, implies that each item has been received and approved and the charges found to be correct.

14. Where any expense is accounted for by the piece, pound, yard, bushel, hundred, etc., the entry should be as follows:

12 Meals, at 20 cents, ...	$2 40
15 lbs. butter at 30 cents, ...	4 50
2 dozen lanterns at $2.00, ...	4 00

15. Copies of all bills, receipts, payrolls, etc., must be kept in office of each forester, and properly filed.

16. Whenever possible, pay expenses by check, indicating clearly on the stub the items for which the check is drawn.

17. No person in the employ of the Department has any authority or legal right to sign another person's name for any purpose whatever. The person who is to receive the money must sign his own name and if unable to do so, must make his mark in the usual way. The mark must be accompanied by the signature of a witness.

The form of signature is as follows:

his
John X Smith. Witness: Charles Brown.
mark

18. The general rule of fully itemized bills prevails, and every employe must take notice. Follow the practice of getting, whenever possible, bills itemized on the printed bill heads of the person to whom the money is paid.

19. Be sure to forward all bills and receipts with the voucher to which they are to be attached.

20. All bills, receipts, pay rolls and vouchers should be forwarded

to the office not later than Tuesday previous to Commission meeting, which is on the first Friday of each month.

5 and 6.

Forest Academy Vouchers.

Used only for Academy expenses.

7.

Receipt.

1. Take receipts on this form for all expenditures possible, other than those for which receipted bills are obtained.
2. No receipt need be taken for trolley fare, railroad fare, telephone and telegraph charges, single meals at restaurants or on dining car enroute, cab or hack hire.
3. Itemize each expenditure fully.
4. Pay expenses by check whenever possible.
5. Always begin receipt by name of place where the expenditure is made and follow with date of payment.
6. If receipts are taken for lodging or meals, indicate by date; if for more than self, indicate number of men, e. g.,

Aug. 1, 1911, Supper and lodging for 7 men at 25 cents,	$3 50
Aug. 2, 1911, Breakfast and dinner for 7 men at 25 cents,	3 50
Aug. 3, 1911, Dinner for 2 men at 35 cents,	70
Aug. 3, 1911, Feed for two horses,	50

7. For further information, see instructions under Forms 3 and 4.
8. Be sure to stamp "Received-Correct-Approved" and countersign.
9. Date upon which material is furnished or service rendered should always be given.
10. Postage stamps must be receipted for by postmaster.

8.

This form is used only by the Commissioner of Forestry, and is for the payment of the annual charge against the forest reserves for school purposes.

9.

This form is used only by the Commissioner of Forestry, and is for the payment of the annual charge against the forest reserves for road purposes.

10.

This form is used by the Commissioner of Forestry to accept or refuse title, for the Commonwealth, to vacant land, for which application has been filed with the Secretary of Internal Affairs, notification of which has been made to the Department in accordance with Act of May 3, 1909.

11.

Land Offer.

This form is given to individuals desiring to sell land to the State. A copy of the offer is made on a similar form and sent to a forester or inspector with instructions to examine the land previous to purchase. The report of the examiner is written upon the back of the form and returned by him to the Department. This report should state,

1. Whether or not the land offered is the land shown, if it is possible so to determine.
2. Whether it adjoins State land.
3. Character of the growth, species present, and relative percentage of total stand; age, height, diameter, density, quality of trees.
4. Soil.
5. Roads.
6. Streams.
7. Distance from market.
8. Other data.

Then should follow an estimate of the tract's worth, judging by past purchases in the same neighborhood.

12.

Contract for Purchase of Land.

Used only by the Commissioner of Forestry.

13.

Timber Cut.

1. This form is sent to those who do any wood cutting or sawing from the stump.
2. Each forester should report his cut on this form, as well as upon Form 31, so that it may be added into the total cut of the State.
3. Each forester should do all he can toward helping the Department to obtain information of this kind. Whenever he sees or hears of any individuals doing cutting of any kind, the names and addresses should be forwarded to the Commissioner of Forestry.

14.

Tabulation of Timber Cut.

Used only in the Office of the Department.

15.

Forest Fire Report.

1. For instructions concerning this form, see the form itself.
2. Each forester should keep a copy of each report made. Form 19 may be made up, to a large extent, with the aid of these reports.

16.

Bill for Extinction of Forest Fire.

1. For instructions, see the form itself.
2. It is important that these bills be forwarded as soon as possible after the fire has occurred.
3. A copy of each fire bill must be attached to the duplicate fire report, Form 15, and filed.

17.

Fire Loss.

1. These forms are sent out each year by the Department in order to get data on loss by forest fires.

2. Foresters should fill out one of these blanks each year for the loss on the reserve of which he has charge.

3. The statements made should be carefully figured out before being set down. The loss may be made up of actual property destroyed, whether trees are standing or not, young trees not yet marketable, humus and soil. Any special features making the forest particularly desirable should be capitalized if the forest is destroyed.

18.

Tabulation of Fire Loss.

Used only in Office of the Department.

19.

Summary of Fires.

1. This form is to be incorporated as a part of each forester's annual report.

2. The record of each fire should be made as soon as possible after the fire has occurred.

3. All fires at which the forester or any of his men assisted in extinction, should be reported on this form. Small fires as well as large ones must be reported.

4. In reporting damage, it is better to indicate the character of the damage rather than the value. As in the case of Form 17, reference should be made to extent of damage done to young and old trees, stating whether they have been killed, badly or slightly damaged, the species most affected, etc. Especial mention should be made of damage done to any regeneration which may have been present.

5. In reporting damage to forest floor, it should be stated whether merely the surface leaves, or a part or the whole of the humus has been destroyed; also something as to the condition of the live cover of the floor before and after the fire. Sometimes damage to the soil itself may be noted.

6. Damage to game, or birds, or other features making the forest particularly attractive should be noted.

7. It will be of great interest to keep records of the time of day when fires come to the attention of the forestry officials and the time of day at which they have been extinguished. If patrol is necessary after extinction, a note should indicate the fact, and the time elapsed before everything was considered safe.

8. Total cost of extinction should include the value of the time spent by forestry officials and employees, and expenses. If individuals assist who are not paid by the Department or from the appropriation for Extinction of Forest Fires, an effort should be made to learn what time and expense they have had and make proper report on this form.

9. Be sure the cause is known before recording it. Do not guess at it. If it is unknown, enter it as such.

20.

State Forest Reserve Rules.

1. Each forester should see that his reserve is well posted with these cloth notices.

2. They should be placed along all roads, especially near where the line of the reserve crosses a road and where roads fork or cross, at the mouth of streams, along streams, and near camp sites.

3. When notices fade or are removed for any reason, see that new ones are posted.

4. Be careful not to place the notices on trees which are likely to become valuable timber trees. Try to find old, defective trees, or trees of little value.

5. Become thoroughly familiar with these rules.

21.

Application for Camp Permit.

1. The important thing about the application is that each individual most subscribe to the rules and regulations of the reserve. After the application has been properly filled and received at the Department of Forestry, if there is no objection to the individuals, or if there is no previous application for the same camp site, a permit will be granted.

22.

Camp Permit.

1. These permits must be had before any one may camp over night upon a reserve. A copy of each permit is sent to the forester in charge of the reserve upon which the camp is to be located. If any one is found to camp upon a reserve without a permit from the Department, he is liable to fine or imprisonment, or both. (See Act of May 5, 1911.)

2. Every effort should be made by the members of the forest service to keep the Department informed as to the desirability or non-desirability of granting a permit to any one of the community or to any individual having improperly or illegally conducted himself upon the reserve.

3. Each forester should report to the Department all cases in which campers fail to notify him previous to locating their camp.

4. Under no circumstance must a forest official charge or collect any remuneration for rendering assistance in the location of a camp.

5. In case of campers locating upon a reserve, where there is every reason to believe that they are ignorant of the regulations, leniency should be shown. Have each one sign an application blank and forward it with explanatory letter at once to the Department and permit will be returned to forester.

23.

Surveyors Daily Notes.

1. Notes of final running are to be entered in ink each day on this form.

2. Sketches are to be made on right hand side of sheet.
3. Sheets are to be sent to the Department weekly.
4. Enter final courses and distances only.

24.

Daily Record.

1. The object of this report is that the Department may keep closely in touch with the work being done on the reserves.

2. For the foresters, they are of inestimable value in that at the end of each month the work of all rangers, and foresters as well, may be properly classified and charged to the proper accounts.

3. With these ideas in view, this report should become a diary of each man in the service. The exact location and character of work done should be set forth in detail for each day, as well as the amount of time in hours spent at each operation; also in red ink the accoun or accounts to which each days work is charged. No one should hesitate to tell exactly where he has been and what he has been doing.

4. The time of foresters and rangers costs value to the State, and consequently should be accounted for just as other expenses must be, and the time spent at each operation, or kind of service, should be charged against that operation or service at a rate per hour, determined by dividing the salary per month by 250, which rate shall be known as the "service" rate.

5. When each operation, other than distinctly administrative duties, has been properly charged for time given it at the "service" rate, the sum of the items should be taken; the difference between the forester's monthly salary and this sum should be charged to general administration. In case the sum of the items amounts to more than the monthly salary, the difference may be credited in the general administration account.

6. It must not be assumed that 250 hours is the amount of time which a forester or ranger is expected to work, no more or no less. That number has been chosen to determine the rate per hour to be charged against operations simply as a matter of convenience and uniformity. Men in the forest service do not work overtime; they are in the service of the State from the time they enter its employ until they leave it.

7. In the case of the ranger's time, each operation is charged properly and the difference between salary and the sum of separate items is charged to general protection account. If the sum of operation charges is greater than the salary, the difference may be placed to the credit of protection account.

8. Operations should be charged for rangers' and foresters' time in the same manner as charges for other time. If the forester would have to pay for time to and from the operation, in case a man were employed to do the work performed, then the time occupied by forester or ranger in getting to and from the operation should be charged against it. Otherwise an operation should be charged only for time actually spent at it. Time in transit may be omitted in reports and consequently will be made up in charge to administration or protection.

9. Absence from the reserve should be indicated by "Absent on leave." If on Department or reserve work the nature of the work should be indicated.

10. This form has to do only with the time of foresters and rangers and not with expenses of any other nature. Therefore, in the space for account charges, foresters will enter on their reports only the proper charges, determined from the report of their own time. In the proper space on each ranger's report, foresters will enter only such charges as arise from the particular ranger's time.

11. After the forester has received a ranger's report in duplicate he should examine it and if found to be satisfactory to him, he should stamp it with the "Received-Correct-Approved" stamp and countersign it under the ranger's signature. All assistance necessary should be given to the ranger so that he may make his reports in proper form.

12. Each day's record should be written in the evening of that day. Happenings will occur and observations will be made that, if not recorded at once, may be forgotten and entirely lost. When daily entries are impossible the record should be made at the first opportunity.

13. Promptness in forwarding to foresters and to the Department is expected. All reports must reach the Department by the evening of the fifth (5th) of each month. For each day of delay thereafter one dollar ($1.00) will be deducted from the forester's or ranger's salary check. A record will be kept of all delinquencies during the calendar year, and deductions will be made from the February pay check. Foresters must not hold other reports because of a delinquent ranger, but should send within the time limit what is on hand. Foresters must see that their rangers are not delinquent, as they will be charged with the penalty in the first instance. Penalties may be removed from foresters and charged to rangers only on presentation of proper evidence.

14. Duplicate copies should always be filed in the reserve office.

25.

Time Sheet.

1. This form was adopted because it has been used successfully by large corporations desiring a record of labor in detail. It suits the needs of reserve records. However, Form 26 may be used in its stead.

2. The name of the month is to be entered after the words "Month of." Beneath the days of the week, "Monday," "Tuesday," etc., should be entered the date in figures, as

Monday Tuesday
25 26 etc.

3. The forester, ranger or foreman who keeps the time should enter each new name in the proper column at the time the man begins work.

4. Each day's work of each individual should be designated in such a way that there can be no possible doubt as to the operation or compartment against which a charge must be made.

5. Uniformity and clearness of terms is necessary.

6. Each day's record should be made at the end of the day.

7. Totals should be carefully checked and entered at the end of the week.

8. Transfers are made from this form to Form 26.

9. After everything has been properly transferred and the amounts checked, the form should be filed.

10. Do not file until you are sure every entry is correct and that transfers have been made correctly.

26.

Labor Account.

1. This form was devised with the idea of using it as a summary sheet.

2. The heading will appear when filled, as follows:

Labor for the month of March, 1911.
Account Crooker's Run Road.

3. At the end of each week, the time sheets (Form 25) are carefully gone over, and when labor has bee ndone on Crooker's Run Road, the name of the individual is transferred, and the number of hours entered under the proper date. The rate paid is entered under its proper column.

4. Do not overload the reserve files, but at the same time, remember that crowding entries is unnecessary and should never be done.

5. Subdivisions of an account may be indicated upon one sheet, as for example, in the account above, there may be "Clearing Right of Way," "Dynamiting," "Grading," etc.

6. Two distinct accounts should never appear on the same sheet. However, a continuation of the account for another month may be satisfactory.

7. When a month's work has been properly distributed, the totals of all account sheets should agree with the totals of the time sheets for the respective month.

8. All totals should be carefully checked before making up the pay roll (Form 27).

9. All accounts for the month should be closed on Saturday previous to the Commission meeting so that the pay roll may be made up and forwarded to the Department with other bills of expense, in plenty of time for consideration on the following Friday.

10. Totals of each sheet, or of each sub-division of an account, should be transferred to the ledger account and so indicated in column marked "ledger folio."

(a) The above system necessitates, in many cases, a duplication of names, and for this reason a sheet has been used by some foresters for each employe. Form 25 is eliminated. The different kinds of labor are indicated in the column provided for names.

(b) The advantages of this method of use is that if the rates of wages differ with different work, they may be recorded without crowding any figures. Further, the total of each sheet may be transferred directly to the pay roll, whereas in the other method each individual's time must be collected from a number of sheets.

(c) On the other hand, unless it is desired to enter the value of each man's labor in the respective ledger accounts, and to which there can be no objection, these items must be collected from the various sheets and entered as a total for the month.

11. Either method may be adopted, but when once adopted, should

be adhered to in its entirety. If it is found to be more convenient to use the other method, a change may be made, but the change must be complete.

27.

Pay Roll.

1. The pay roll is to be forwarded to the Department as soon as possible after the closing of each month. It must be done not later than the Tuesday preceding the first Friday in each month.
2. No pay roll should be forwarded until the forester has verifiec its figures and found them to be correct.
3. Enter each man's name when he is first employed during the month, and he should sign his name in the column headed "Received payment" at the same time. If this idea is carried out, the forester will not be delayed at the end of the month in hunting his men foı their signatures.
4. With reference to signatures, see item 22 under Forms 3 and 4.
5. Do not allow any person to receipt the pay roll for the amount due another.
6. Do not neglect to stamp the pay roll "Received-Correct-Approved" and countersign.
7. Never use ¼ hours on pay roll. Allow time to the nearest half hour only. Good judgment will determine when to give or take, and yet not be unjust to the employe or to the Commonwealth.
8. When the rate for labor is above the ordinary rate per hour for day labor, always indicate after the man's name the kind of labor which calls for the extraordinary rate, as for example, James Smith (Carpenter).
9. In case of surveys, pay for service, hauling and boarding should go on pay roll at rate per hour, or rate per meal. Total number of meals furnished entire crew each day must be entered per day in same manner as number of hours worked by each man. Receipts must be furnished for all other expenses incurred in the survey.

28 and 29.

Department Bill Heads.

1. It is good business practice to give a receipted bill for all material sold for which money has been received.
2. While all State business is expected to be a cash business, there will be transactions in which some time will elapse between the purchase of material and the payment for it. In such cases a statement, on either of these forms, should be sent at the end of each month to the individual still owing the Commonwealth.
3. When payment is made, receipt the bill as follows:

   Received payment 10/12/12.

   (Signed) William H. Kraft, Forester.

4. Do not use this form as a bill head for any individual,

30.

Statement of Finances.

1. This form should be filled out and forwarded to the Department at the end of each month. The heading will then be:

Statement for November, 1912.

2. It shows all the accounts of operations, or accounts by compartments which the forester has opened in his ledger.

3. A new account will have entries first, either in the receipt or in the expense column or in both.

(a) If expenses exceed receipts, the difference is placed in Dr. column immediately following expense column, and is a debit balance.

(b) If receipts exceed expenses, the difference is entered in the Cr. column at the extreme right of the form, and is a credit balance.

4. For the succeeding month the form will appear:

(a) Statement for December, 1912.
Balances of November.

(b) The debit or credit balances will be placed in the proper column under "Balances for November."

(c) New receipts or expenses will be entered in place.

(d) Receipts are considered as a credit item. Expenses become a debit item. Add receipts to credit balance and expenses to debit balance; subtract the two amounts, and the difference is placed in the Dr. or Cr. column according as to whether the debit or credit amount is the larger. As for example: An account at the end of November shows a debit balance of $50.49; during December, receipts to the amount of $18.50 were collected from the sale of material produced by the operation and there was an additional expense of $5.37. The December balance is determined by adding $5.37 to $50.49, which amounts to $55.86, and subtracting $18.30, leaving $37.56. Since the debit side of the account is the larger, this is a debit balance and must be entered in the debit column.

5. If expenses are paid, or material furnished directly from the Department, such expenses should be entered in red ink after the proper accounts, as a separate entry.

6. If, upon authority from the Department, money received from sale of material is used to defray all or part of any expenditure, such expense should be entered in red ink, also, but as a separate entry and enclosed in parenthesis.

7. The total of all black ink entries in the expense column should equal the total of all checks received from the Department for the month's expenses.

8. When any money from receipts is forwarded to the Department, a note and explanation should be entered on the month's statement.

9. This form will be used to present a summary statement of finances to be included in annual reports of foresters. (See Item 25 of Outline.)

(a) In this case the heading will be as follows:

Statement for the Year 1912.

(b) The balances existing at the end of the previous year will be inserted in the first two columns; the total receipts and expenses for the current year will be inserted in their proper columns and the final balances should be the same as those for December.

(c) All expenses during the year paid, or material furnished, didectly by the Department, should be entered in red ink.

(d) Money paid from receipts on reserve should likewise be entered separately in red ink and inclosed in parenthesis.

(e) The total of all money forwarded to the Department should be indicated, as well as the balance of receipts on hand.

31.

Forest Products.

1. In order to determine the development and possibility of the forest it is necessary to keep an accurate record of yields according to species and products.

2. The only safe basis for computation is that of solid cubic feet of wood, exclusive of bark. If bark is sold with or without wood, a separate statement of quantity and price should be given. The individual forester is the only one who can determine this volume. He knows the number and quantities of various products and can readily determine the factor for reduction to cubic feet. No fast rule of thumb can be laid down for this purpose.

3. Exact measurements should be taken whenever possible and experiments made from time to time in order to determine the factor for a particular kind or quality of produce. The results of such experiments and exact details thereof should be carefully recorded and kept on file.

4. Prices given should be those of various sizes, classes, and qualities of material when ready to be removed from the reserve.

5. Data should be kept in each operation so that the forester may easily determine the stumpage value of various species and sizes of trees when made into various products. It is only in this way that it will become possible to determine the most satisfactory rotation and species for various localities and conditions.

6. If more than one species has been cut on one compartment enter the amounts cut of each species on separate lines, in the four columns provided for species, and make separate distribution into product columns for each amount.

7. Bark may be entered in "By-product" column but mark it as such. Other by-produtcs might be tree seed, charcoal, or anything, other than wood, that may be derived from the trees of the reserve.

32.

Financial Receipts.

1. The acreage to be given in the second column is that which can be used for wood production.

2. The third column calls for cubic feet and means solid cubic feet of wood, exclusive of bark.

3. If bark, alone or with wood, is sold by weight, some statement should be made to this effect and quantity given.

4. "Gross receipts" means the total value received for a product.

5. "Net receipts" means the receipts from a product after deductions have been made for expenses connected with the manufacture and sale of the product.

6. If material is sold on the stump and no charges except for super-

vision are made, the receipts would be entered as gross receipts and the charges for supervision, so marked, should be entered in column for cost of harvesting.

7. Minerals are usually sold on lease and consequently may be entered directly in net receipts column.

33.

Plantation Report.

1. For reserve record, one report sheet should be made for each plantation, as soon as the plantation has been made.
2. Each plantation on a reserve should be numbered consecutively and the record filed accordingly.
3. The location of the plantation should be definitely set forth.
4. Be accurate as to area planted. Make a survey when possible. The area to be entered in second column is the number of acres within the compartment which can be used for wood production.
5. Always describe in detail the method of making the plantation. If seed be used, indicate whether spot, strip, or broadcast sowing.
6. Give planting distance.
7. Specify for each plantation, age, species of plants used, or species of seeds.
8. Give data concerning soil conditions, condition of growth present, etc.
9. Describe the preparation of the soil, if any, fencing, or other protection necessary.
10. Give detail account of expenses connected with making the plantation, including forester's and ranger's time, as well as the items of expense indicated on the form.
11. In summing up total expense and determining cost per acre, make sure the figures are correct before placing them on the form.
12. For annual report to Department, one sheet may be used for several plantations.
13. If two or more species have been planted in mixture or if each species is planted on a small area, the areas adjoining each other, one plantation record is sufficient. If, however, large contiguous areas are planted pure with different species, it will be better to make a plantation record for each area and species.

34.

Annual Planting Report.

1. This form is intended as a summary of seeds and seedlings planted on reserves.
2. The figures on this form must correspond with the totals of Plantation Records for the year.
3. Seeds collected and planted on the same reserve should be indicated in red ink so as to distinguish such from seed furnished by another forester or purchased by the Department.
4. Seedlings raised and planted on the same reserve should be indicated in red ink so as to distinguish them from seedlings furnished by other nurseries.
5. Do not place on this form the amount of seed collected but not

planted on the reserve. Such a statement should appear elsewhere in the Annual Report (Item 12 of Outline).

6. Be sure to distinguish and place in the proper columns seeds planted in a nursery and those planted in permanent plantation.

7. If seeds or seedlings, the botanical names of which are not found in the list on the form, are planted, indicate the proper name in the blank spaces. The nomenclature of Gray's New Manual of Botany, Seventh Edition, is to be used.

8. Any plant raised from a seed is a seedling. The age of a seedling is determined by the number of growing seasons through which it has passed. A seedling having completed its first season of growth is designated as "a one year old seedling," irrespective of when the seed was sown. It remains a one year old seedling until the second season's growth begins, when it may be said to be in its second summer, but it does not become a two year old seedling until the second season's growth is completed.

Even though seedlings may have a new season's growth started in the spring when they are planted or transplanted, they are still designated by their age of the previous winter.

9. The age of transplants is determined by the number of growing seasons through which they have passed.

A seedling transplanted at the end of the first season's growth or at the beginning of the second and remaining in the transplant bed throughout the second season of growth, is two years old and may be designated as a two-year old transplant, or represented by the figures 1-1.

A seedling two years old, transplanted at the end of the second season's growth or at the beginning of the third and remaining in the transplant bed throughout the third and fourth seasons of growth, is four years old and may be designated as a four year old transplant, two years transplanted, or represented by the figures, 2-2.

35.

Plantation Growth Record.

It is absolutely necessary that the Department of Forestry collect uniform data with reference to the growth of trees in artificial plantations, upon which may be based future sylvicultural and financial plans. This form will serve for such purpose.

1. One sheet should be used for each plantation or for each species in the plantation.

2. This record sheet should be related to Form 33 by entering upon it the consecutive number of the plantation which it concerns.

3. Cross out "Seeds" or "Seedlings," according to what was used in making the plantation.

4. "Age of Seedlings" refers to the age of the plants when they were set in plantation.

5. In planting seeds, there may be spot, strip, or broadcast method of sowing, and various details connected with each. In planting seedlings, there may be hole, mound, split sod, and various other methods and details connected therewith. These details should be set forth either on the back of this sheet or on Form 33.

6. The second column, "Age of Trees," should give the age of the trees from seed.

7. During the first ten years of a plantation, height growth may be measured annually or biennially.

8. From the tenth year, measurements of both height and diameter may be taken at five year intervals, preferably when the trees are 10, 15, 20, 25, and so on, years of age.

9. Measurements should be made during the resting period of growth.

10. Diameter measurements should be made at the same height, and at approximately the same temperature. (Breast height is four and one-half feet above ground.)

11. Height growth should be given in feet and tenths of feet; diameter growth should be given in inches and tenths of inches; volume growth should be given in cubic feet and to three decimals.

12. Maximum current height growth is the greatest growth in height of any one tree during the season of growth just passed.

13. The average current height growth is determined by adding the lengths of the past year's shoots of all the trees in the plantation and dividing the sum thus obtained by the number of trees.

14. The mean annual height growth of a plantation is determined by adding the total heights of all trees in the plantation and dividing the sum by the number of trees to obtain the average height at the time of measurement. This average must then be divided by the number of years the trees are old.

15. The mean annual diameter growth is determined by adding the sectional areas of all trees in the plantations, as found from diameter measurements, and dividing the sum by the number of trees in the plantation. The result will be the average sectional area at the time of measurement. From this may be found the average diameter. The average diameter is then divided by the number of years the trees are old to obtain the mean annual diameter growth.

16. Having the average height and diameter of the trees in a plantation at any time, the volume of such a tree is determined by finding a tree of such size and making careful volume measurements of it. The volume of such a tree, called the "mean sample tree," multiplied by the number of trees in the plantation, will give the volume of the whole plantation. (See Graves' Mensuration, pp. 228 and 229.) This volume divided by the number of years the trees are old will give the mean annual volume growth.

17. When material is removed, the date should be given.

18. Explanation of Crown Classes:

Predominant—When the crown of the tree is partially or wholly above the general level of the top of the canopy.

Dominant—When the crown has light from above and very little from the side, being one of those making up the more or less even canopy height.

Intermediate—When the crown has no light from side and only a small amount from the top.

Suppressed—When the crown receives no light from top or side and the tree is in a weakened condition by reason of insufficient light.

36.

Roads, Trails and Fire Lanes.

1. A road shall be considered as a way of travel wide enough for the use of wagons, having been so used or to be used, and is supposed to be made bare of growth for at least 6 feet, especially if it is to be a part of the permanent road system.

2. A trail shall be considered as a narrow way for foot travel, or for horse-back riding, and is supposed to be made bare for from one to three feet.

3. A fire lane shall be considered as a way cleared through brush or forest, where a road or trail would never likely be built, and from which the brush and loose debris are removed. The width may be from 4 to 20 feet, of which at least one foot should be made bare.

4. When a road or trail has been laid out and the right of way cleared of brush only, it should not be reported as a fire lane.

5. A trail may, at some time, become a road, or a road, by discontinued use, may become a trail. Either or both may be abandoned.

6. Any changes in conditions should be noted, and reasons for them given.

7. Brush may be removed from either side of a road or trail to any distance permitted, but not change the character of the way. The brush removal should extend no farther than is necessary. Bare soil is better than great width of open space.

8. Distinguish carefully between extension and improvement.

(a) Extension refers to an entirely new road, trail or fire lane, where none has existed previously.

(b) Improvement refers to work done upon old roads or trails now existing, or upon new roads after having been considered completed and repairs become necessary.

9. Each road, trail, or fire lane should be designated definitely and its termini definitely determined from time to time.

10. Grading refers to the establishment of the general grade of a road or trail, as indicated by its rise or fall in length and includes the cost of survey.

11. Ditching refers to the accomplishment of good drainage by ditches on inside of road, cross-drains or sub-drainage.

12. Surfacing refers to rounding up the road after it has been graded and ditched, either with earth, gravel, stone or other material necessary to complete the work and make a finished road.

13. The cost of extension should be indicated by the rate per 100 feet of distance extended.

14. All improvements and repairs should be reported on the basis of cost per 100 feet of total length of road.

15. Notice that the column headed "Length" is under "extension" and in it should be placed the length of extension of new road, trail, or fire lane, and not the total length of the road. The latter may be indicated in small figures in the column headed "Roads, Trails, or Fire Lanes."

16. In summary to Department in Annual Report, use one sheet for roads, one for trails and one for fire lanes.

17. Brushed boundary lines should be so indicated and not classed as fire lanes, although they may be reported upon this form as well as under item 3 of report outline.

18. All roads, trails, streams, and open boundary lines are fire lanes in effect but should not be reported as such.

37.

Descriptions of Compartments.

Forms 37, 38 and 39 are very important as a basis of future forest management. It is not expected that exact data can be recorded upon them at present, but an effort should be made to cover the whole reserve and make proper entries on these forms, recording everything as far as possible at present. From time to time proper revisions may be made. In no case should the preliminary sheets be destroyed.

1. It should be remembered that the compartment is the smallest unit of management, should be bounded by geographic features, roads, or trails, as far as possible, and should not exceed 300 acres.
2. For the time being, warrants may be used in place of compartments, if their locations are definitely known.
3. A "blank" is a portion of the timber producing area, having no trees or but a few, hence necessitating a complete restocking. It does not include any areas not intended for wood production. In some cases the latter areas may have a thin stocking which may give a small return from time to time.
4. Under "Sylvicultural System" may be given any past history with reference to the growth.
5. "Quality of Locality" may be indicated by Roman numbers.
6. "Quality of Growing Stock" may be indicated by decimals and should comprehend density and condition of trees.
7. Under "Remarks" may be stated something descriptive of present conditions and of suggested future treatment.
8. Do not be afraid to use paper in giving details.

38.

Table of Areas.

This form is self explanatory and requires only a careful estimate or survey of areas.

39.

Tables of Qualities of Locality.

By "Quality of Locality" is meant the yield capacity as expressed by the quantity of produce which can be derived from the locality.

1. Under "Species and Sylvicultural System" should be noted conditions at present.
2. The following table shall determine the quality class.
   - I. (Best) Areas capable of producing per acre per annum 100 solid cubic feet of wood or more.
   - II. Areas capable of producing over 75 and less than 100 solid cubic feet of wood.
   - III. Areas capable of producing over 50 and less than 75 solid cubic feet of wood.
   - IV. Areas capable of producing over 30 and less than 50 solid cubic feet of wood.
   - V. (Poorest) Areas capable of producing over 10 and less than 30 solid cubic feet of wood.
3. Remarks should cover any matters which will set forth present conditions in any clearer light.

40.

Valuation Survey.

There are many methods of making a valuation survey, but this form is adapted to most of them.

1. Each sheet should be dated on the day the notes are entered.
2. "Locality" refers to quality of locality.
3. "Area" refers to the area which is being worked, as either the total area or the unit or area.
4. "Number" is that of the sheet covering the area indicated.
5. Calipering should be done carefully, paying attention to
   (a) Position of calipers. They should be at right angle to the axis of the tree.
   (b) Uniform height of measurement should be maintained.
   (c) Swellings, knots, vines, etc., should be avoided.
   (d) Average diameter should be read.
6. Except in case of very exact work, diameters may be entered in two-inch classes.

41.

Tree Analysis.

"The measurement of a felled tree to determine its growth is called a tree analysis." H. S. Graves.

1. Date should be entered, the day the analysis is made.
2. "Type" refers to type of tree, as predominant, dominant, or suppressed, etc.
3. "Locality" refers to quality of locality.
4. "Height of Cross Section" refers to the number of feet above ground at which the annual rings are counted and measured.
5. To determine the age of the tree, determine the number of years required for the tree to reach the height of the cross section, by examination of small seedlings or sprouts in the neighborhood; e. g., if the tree is cut at one foot from the ground and is a white pine, it may have required five years to reach that height. Then count the number of rings from centre to bark; add five for the total age.
6. If the cross section is one foot above ground and it took five years to reach that height, the radius at one foot when five years old was 0. At ten years the radius was the distance from centre to outside of the 5th annual ring; at 15 years the distance from centre to tenth annual ring, and so on.
7. Suppose the tree is 87 years old and the cross-section is 40 feet high. We determine first where the annual ring laid on in the 80th year of growth is by counting seven rings from the bark. The radius at 80 years at this height is the distance from centre to the outside of the ring, outside of which there are still seven rings.

Counting ten rings toward the center determines the annual deposit of wood made in the 70th year of the tree's life, and so on.

There may be a number of rings from the place of last measurement to center, say, 8. It would mean, if in all there were 25 rings on the cross-section, that it required 62 years to reach a height of 40 feet; in other words, 87 minus 25 equals 62.

8. "Diameter B. H." refers to diameter at 4½ feet above ground, outside of bark.

9. "Merchantable Length" refers to the total length of stem that might possibly be used, if taken to the lowest diameter which can be utilized in any market.

10. When analysis is made for accurate results, the tree should be cut into sections not longer than four feet.

(a) The tree must be cut off as close to the ground as possible.

(b) The next cut must be at exactly two feet above stump cut.

(c) The last two cuts must be made two feet apart.

(d) In computing volume the portion of the tree above the last cut must be considered as a cone.

11. The name of the person making the analysis must be on each sheet.

42.

Tree Volume.

This sheet is to be used for recording the final figures in working up tree volume from data on Form 41.

1. Date should be the day upon which the calculations are made.

2. "Species," "No. of Tree," "Type," and "Locality," should correspond with the entries on Form 41, from which the necessary data are taken.

3. "Type" again refers to type of trees.

4. "Locality" refers to quality of locality.

5. The first computation will be to calculate the volume of the whole tree, including bark (branch wood may or may not have been considered in the analysis).

(a) The stump will be regarded as a cylinder.

(b) Each log shall be regarded as a truncate paraboloid the volume of which equals one-half the sum of the sectional area of top plus the sectional area of the base, multiplied by the length. Represented in formula $V = \frac{S+s}{2} \times L$

(c) What is left above the last log is considered as a cone.

6. The second computation is to find the volume of the whole tree without bark.

7. The next computations are for the volume of the tree, without bark, at specific ages, as seventy, sixty, fifty, forty years, and so on.

8. In the case of special analysis as under item 10, Form 41, the second cross-section is regarded as the sectional area in the middle of a four foot truncated paraboloid, the volume of which is found by multiplying the sectional area in the middle by the length, which in each instance in this case is 4. Refer to Vol. III Schlich's Manual of Forestry, 3rd Edition, page 30.

43.

Application for Examination for Admission to the State Forest Academy.

This form must be used by all who desire to take the examinations. They may be had by writing to the Department.

44.

Academy Contract—Major.

To be entered into by those who receive appointments to the Acaemy as students, and who are past their majority.

45.

Academy Contract—Minor.

Same as above, except to be entered into by those who have not yet reached their majority.

46.

Academy Bond.

To be entered into by all who receive appointments as students at the State Forest Academy.

47.

Nursery Certificate Shipping Tag.

1. One of these shipping tags, with the certificate properly filled up, must be attached to each package of seedlings sent from any of the inspected nurseries. This is required by law.
2. Do not use this form for the address card when it must be attached to a box. Use an ordinary plain shipping tag.

48.

Application for Forest Tree Seedlings.

This form will be sent from the Department to all private individuals (not to foresters on reserves) who desire seedlings from the Department nurseries.

49.

Lightning Report.

1. This form is to be filled up by foresters, rangers, and any other observers the forester may be able to interest in the work.
2. Definite areas will have to be designated where two observers might be likely to make duplications.

50.

Nursery Operation Sheet.

The purpose of this form is that the forester may tabulate nursery expenses, so as to be able better to determine the cost of raising seedlings of various ages and species.

51.

Nursery Shipment Card (green).

1. The nurseryman must fill up this card at the same time as Form 52, and send it to the individual to whom seedlings are shipped as

soon as shipment is made. (In case of private individual, card is sent to Commissioner of Forestry.)

2. The forester receiving seedlings will retain this card, and as the seedlings are planted make note of their number, size, and quality upon the back of the form.

3. If seedlings are received in the fall and some have to be heeled in over winter for any reason, a statement concerning the matter should also be placed on the back of this form.

4. If any seedlings have been lost or destroyed, a statement should be made giving whatever information is available.

5. As soon as the shipment is checked by forester receiving it and the proper memoranda made upon the back of the form, it must be sent to the Commissioner of Forestry.

6. Nurserymen should call the attention of express agents to the fact that seedlings have a special low rate.

52.

Receipt for Nursery Stock (yellow).

1. One of these cards must be filled up by the nurseryman for each shipment and sent to the individual to whom the seedlings are sent together with Form 51. (In the case of private individuals both forms for each shipment must be forwarded promptly to the Commissioner of Forestry, who will then notify the person to whom seedlings have been sent.)

2. After seedlings have been received and checked carefully, the forester will place his signature upon the card, and upon the back of it note whether the shipment was correct, condition in which seedlings were received, general condition and quality of seedlings, and any other information of value to the nurseryman. Then the card must be returned promptly to the nurseryman from whom it was received.

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Bulletin #8

PENNSYLVANIA DEPARTMENT OF FORESTRY

STATE FOREST ACADEMY

MONT ALTO, FRANKLIN COUNTY, PA.

GENERAL VIEW OF BUILDINGS

TENTH ANNIVERSARY 1903-1913

HARRISBURG, PA.:
WM. STANLEY RAY, STATE PRINTER,
1913

PENNSYLVANIA DEPARTMENT OF FORESTRY

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PENNSYLVANIA DEPARTMENT OF FORESTRY

ROBERT S. CONKLIN,
Commissioner of Forestry
IRVIN C. WILLIAMS,
Deputy Commissioner of Forestry

STATE FORESTRY RESERVATION COMMISSION

ROBERT S. CONKLIN, *President*
JOSEPH T. ROTHROCK
MIRA LLOYD DOCK
SIMON B. ELLIOTT
J. LINN HARRIS

A CROP WORTH GROWING.
Forestry Grown White Pine—13 Years and 58 Years Old.
500 to 800 Board Feet Per Acre Per Year.

FOREWORD.

The Pennsylvania Department of Forestry is undertaking the huge task of restoring the forests of the State to their original productive condition when they yielded abundant revenue to the owners, steady work for the laboring men, and healthful living conditions to all through their pure water supply, stream regulation, and prevention of erosion. To develop the one million acres of forest land purchased by the State trained foresters were needed and since no institution in the State could or would furnish them, the State Forest Academy was organized ten years ago.

The following tenth anniversary announcement is made to the people of Pennsylvania to inform them of the past progress and present standing of the school and to bespeak their hearty cooperation in the very urgent restoration of the forests of the State. It is not an extravagant claim to say that the health and prosperity of the entire State hinge on the success or failure of this movement.

THE FACULTY.

EDWIN ALLEN ZIEGLER, A. M.,
Director and Professor of Forestry.

JOSEPH SIMON ILLICK, A.B., B.F.,
Professor of Forestry.

GEORGE AUSTIN RETAN, B. F.,
Professor of Forestry.

WILLIAM NETOFFSKY, B. S. in CH.,
Professor of Chemistry

JOHN CLINTON ADAMS, B. S.,
Professor of Biology.

RECENT LECTURERS.

Dr. J. T. Rothrock, former Commissioner of Forestry and present Member of the Pennsylvania State Forestry Reservation Commission.

S. T. Dana, United States Forest Service.

Hon. S. B. Elliott, Member of the Pennsylvania State Forestry Reservation Commission.

J. Horace McFarland, President American Civic Association.

C. J. Blanchard, United States Reclamation Service.

Mira L. Dock, Member of the Pennsylvania State Forestry Reservation Commission.

William L. Hall, United States Forest Service.

Dr. Marion Mackenzie, Professor of Biology, Temple College.

George H. Wirt, Forest Inspector, Pennsylvania State Forest Service.

Dr. John W. Harshberger, Professor of Botany, University of Pennsylvania.

Dr. Richard C. Scheidt, Professor of Biology, Franklin & Marshall College.

A YOUNG HARDWOOD FOREST UNDER FOREST MANAGEMENT.
Each acre produces ½ to 1 cord of timber each year.

ORIGIN AND DEVELOPMENT.

As early as 1876, in an address before the recently organized American Forestry Association at Philadelphia, Burnett Landreth pointed out the necessity of teaching Forestry as a science in itself and not as a branch of Agriculture. From that time, throughout the period of agitation and public education which preceded the foundation of the Department of Forestry there continued frequent references to the necessity of such a separate course or, better still, of a separate school devoted to the teaching of Forestry. Most of the ideas expressed were based on the European Forest Schools as models but all recognized the necessity of adapting such a school to American needs and conditions. This agitation was especially strong in the years 1888 and 1889. During 1889 the trustees of the University of Pennsylvania established a chair of Forestry to be filled as soon as funds became available, but the chair was never filled.

Public sentiment in favor of forestry was of slow growth particularly among forest owners. Recognizing that this condition must first be remedied by educational work, it was seen that the time was not yet ripe for a technical forest school. So the talk of the necessity of forestal education was not strong until about the year 1900.

In issues of "Forest Leaves," in 1901 and 1902, are found several articles dwelling on the necessity of trained men to do forestry work upon the large areas of land which were rapidly passing into the control of the Forestry Department. Dr. J. T. Rothrock, then Commissioner of Forestry, took the lead in this movement. Endeavors were made to have scientific courses added to the University of Pennsylvania or to Pennsylvania State College. These schools refused at that time to undertake the work. Appreciating the actual need of men and realizing the great advantages of a practical school connected with actual forest work, Dr. Rothrock decided to establish such a school under the control of the Department of Forestry and locate it upon a State reserve. In the spring of 1902 the State Forester, Mr. George H. Wirt, a Biltmore graduate, was sent to Mont Alto to take charge of the property recently purchased from the Mont Alto Iron Company, and establish a forest nursery. Although the legislature of 1901 had refused to adopt Dr. Rothrock's plans, he felt sure that two years would find a change in sentiment, and, as a preliminary measure, four young men, Ralph E. Brock, Charles Delaney, Robert G. Conklin, and Harvey E. Frankenfield were sent to help Mr. Wirt and get some instruction in Forestry. In January, 1903, a German forester, Paul E. Arnold, of Tharandt, was added to the force. By act of May 13, 1903, the school was formally recognized and plans were made for the entrance of the first class. Previously the Commission formally adopted, on June 4, 1902, the curriculum and plan of work submitted by Mr. Wirt for his forest school.

The original idea was that the students admitted should be composed of young men from the wooded districts with practical woods experience and the first class was partly composed of such men, appointed by the Commissioner of Forestry. It was soon recognized that these men were often unable to do the mental work required in a study of scientific forestry and the entrance requirements were made strictly competitive with both physique and mental ability entering into the test. This plan has been constantly adhered to since that time.

At first there was some thought of moving the school to the Caledonia purchase as possessing better facilities, but this was finally given up and the administrative buildings of the old furnace at Mont Alto were utilized for the school. These were far from being ideal and the school was handicapped for some years until in 1908 the first of our modern buildings was erected. Along with the development in material equipment has gone a constant progression in the standard required for entrance and for graduation, until the course has attained its present degree of completeness.

LOCATION.

The Pennsylvania State Forest Academy is located about one mile from Mont Alto, a small village in Franklin County, which is sixty miles southwest of Harrisburg on the Cumberland Valley Railroad. The school is located at the base of the west slope of the South Mountain ridge of the Blue Mountains. The ground occupied by the school buildings is a part of a State forest which affords an opportunity for practical instruction and experimentation equalled by few if any forestry schools. The situation is healthful and the school is supplied with water from a spring located in the interior of the forest. To the west of the school lies the Cumberland Valley which is regarded one of the garden spots of Pennsylvania.

The location of the school stands in strong contrast with those in the larger cities. Such an isolated location has a few disadvantages, recompensed however, by many advantages which make it not only more attractive for study but which allow the students to study things rather than about things.

BUILDINGS AND EQUIPMENT.

The oldest building of the academy group is Wiestling Hall, a large three-story structure, at one time the residence of Colonel George B. Wiestling, a member of the first Forestry Commission of Pennsylvania. The building has recently been remodeled and is used as an administration building.

The main building, constructed of native quartzite, was erected in 1908-1909, at a cost of $30,000.00. On the second floor of this building are comfortable living rooms for all of the students, and for two of the instructors. The whole of the first floor is devoted to class rooms, laboratories, and the library. A part of the basement is also used as a Wood Technology room and contains the collection of wood specimens. There is a complete steam heating equipment and the building is furnished with the necessary toilet rooms and lavatories.

In 1911 a double cottage, now occupied by the Director and another member of the faculty, was built. Another cottage in the academy group is occupied by the forester stationed upon this reserve.

The horses of the junior and senior classes are stabled in a well arranged barn.

Walks and drives have been carefully laid out by a landscape architect, and the buildings are surrounded by spacious lawns which are dotted with many trees and shrubs.

PURPOSE.

The purpose of the Pennsylvania State Forest Academy is to prepare thoroughly trained foresters for the service of the State in its forests. The duties of a forester in the employ of the State require a thorough training and apprenticeship in actual woods work, besides the usual school studies in forestry, the sciences, and a number of cultural subjects. The forester must have an equipment covering the surveying and mapping of his forest; the growing of trees and their proper management from planting, through thinning, to final logging and sawing; the protection of the forest from its arch-enemy, the forest fire, as well as from insects, disease, and trespass; the building and improvement of the forest roads, trails, fire-lines, telephone

FORESTRY STUDENTS PLANTING TREES.

An acre of land is planted with 1,200 trees at a cost, including trees, of $6 to $9.

lines, and fire towers; the estimate of timber and the calculation of its growth, value, and financial returns, the directing of labor; the keeping of records and accounts; and some knowledge of business and forest law. This requires an underlying training in mathematics, botany, zoology, chemistry and geology, as well as history, language, and economics.

The practical application of this training is the large feature of the school, for the entire course may be said to be given in the 25,000 acres of State forest in which the school is located. All the activities of the forester are followed in the woods from the growing of trees from seed in the nursery attached, to the grinding of the forest student's own axe, the cutting of undesirable trees into cordwood, and the mature trees into saw-logs, as well as their manufacture into lumber, lath, and shingles on the school mill; from the day and night fighting of forest fires and the pick and shovel building of roads to the construction of a thorough plan of forest management for a large tract of forest land.

The students return to the State in the form of this labor in the forest a considerable part of the expense incurred in their training. In greater efficiency and enthusiasm in their forest work afterward the State becomes their debtor.

ADMINISTRATION.

The State places on the Commissioner of Forestry, advised by the Forestry Reservation Commission, the responsibility for the carrying on of the school. The immediate charge is placed in the hands of a director and four other instructors, all of whom have enjoyed special training in their respective fields of instruction.

DEGREE.

The degree of Bachelor of Forestry is conferred after the successful completion of the course.

ENTRANCE REQUIREMENTS.

WHO MAY BE ADMITTED? Only citizens of Pennsylvania who are 19 years of age and under 25 on the first day of September, in the year in which the applicant is admitted.

THE PROSPECTIVE STUDENT must make application on a form to be furnished by the Commissioner of Forestry, which will be sent him about one month prior to the date of the examination, and after he has made application by letter to receive the same. The blank form furnished by the Commissioner of Forestry will contain a form of physician's certificate, to be filed with the application.

EXAMINATIONS FOR ADMISSION: These consist of an additional physical examination made by the Department's physicians and a test in scholarship. The examinations will be held during the latter part of June in the city of Harrisburg, and usually occupy two full days. If the physical examination of the applicant discloses satisfactory conditions, he is admitted the following day to the examination in scholarship, which covers the following high school branches: Reading, writing, arithmetic, spelling, United States history, English grammar and composition, physical and commercial geography, physiology, algebra (to and including pure and affected quadratic equations), plane and solid geometry, and civil government. Unless otherwise indicated, the examination will cover the whole subject. No copies of prior examination papers will be furnished.

PRACTICAL EXPERIENCE: As a result of the mental and physical examinations and the report of the examiners to the

Commissioner of Forestry, the fifteen men standing first in the group of those examined will be assigned to Pennsylvania foresters on State forests for practical work and instruction, during a period of two months, beginning about July first. At the end of this period the fifteen men so selected will assemble at the Department of Forestry where they will be subjected to an additional test on practical work in the woods. As a result of this test, ten men of the group who pass the best examination in practical work will be nominated by the Commissioner of Forestry for admission to the Forest Academy on the following September first. Applicants will bear their own expenses while in the reserve for the two-month period.

CONTRACT AND BOND: Each successful applicant receiving an appointment must enter into a contract with the Commonwealth of Pennsylvania for the proper fulfilment of his duties at the Forest Academy during the full course of three years, and then that he will enter the employ of the State after graduation and remain there for a further period of three years as a forester. He must also furnish with his contract a bond in the sum of $500 with sureties to be approved by the Commissioner of Forestry, conditioned that he will faithfully execute his contract. Sureties, if individuals, must be two in number, and show fee simple ownership of Pennsylvania real estate with an equity above all incumbrances of at least the amount of the bond.

EXPENSE: The student will furnish his own clothing for outdoor work, which should be plain, heavy, and strong, and such other clothing of a better character as he may desire to have. He will also furnish at his own expense a horse and riding outfit when so directed by the Commissioner of Forestry. These will not be needed until the beginning of his second year. He will also bear his incidental expenses, which may be little or great, as he chooses.

SERVICE AND SUPPLIES FURNISHED BY THE STATE: Each student will be furnished by the State, free of charge, his tuition, board, room, room outfit, bed clothes, towels, books, stationery, plain washing, the use of a stable for his horse, horse feed, and horse shoeing. Each student must care for his own horse.

DEPOSIT: When a student enters the Academy he must make a deposit of $5.00 in money with the Director, against which will be charged all items of unnecessary, careless, or wilful breakage or damage to State property. Whenever a deposit is lowered by reason of charges against it, the student will be required to increase the deposit at the beginning of each school year to the full amount of $5.00. At the time of graduation there will be returned to him whatever balance may remain to his credit.

POSITIONS AFTER GRADUATION will depend upon the progress made and the standing attained during the three years' course. Salary after graduation for the first year is $60 per month; second year $75 per month; third year $100 per month. When a student enters the employ of the State as a forester, he should retain his horse and riding outfit; but from this time forward the expense of maintenance of self and horse must be met by the forester and not by the Department.

FILLING VACANCIES: Vacancies may be filled at the discretion of the Commissioner of Forestry from among the remaining five men having had the practical training in the forest.

SCHOOL YEAR.

The successful applicants for entrance to the Academy report at the Academy on the first Monday in September. The **first** term lasts until the Christmas holidays (2 weeks). The second **term** lasts from January to the end of May. The **summer term**

FOREST MENSURATION.
Students estimating timber ripe for cutting.

THE LIBRARY

covers the period from June 1 to August 15. The summer vacation (2 weeks), lasts from August 15 to September 1. The school year thus covers forty-eight weeks and the course includes three years or 144 weeks actually spent at work.

ORDER OF STUDIES.

Freshman Year.

	First Term.	Hours.
(20)	Botany I,	6
(16)	Physics,	4
(33)	English,	3
(3)	Elementary Forestry,	5
(34)	Business Law and Bookkeeping,	3
(31)	German I,	3
(25)	Chemistry I,	2

	Second Term.	
(21)	Botany II,	6
(25)	Chemistry I,	6
(33)	English,	3
(6)	Meteorology and Forest Influences,	4
(31)	German I,	3
(15)	Trigonometry,	4
(16)	Physics,	2

SUMMER TERM—Nursery Practice, Improvement Cuttings, (22) Botany III.

Junior Year.

	First Term.	
(4)	Dendrology,	5
(5)	Wood Technology and Timber Physics,	5
(23)	Botany IV,	6

		Hours.
(26)	Chemistry II,	6
(28)	Geology,	4
(32)	Scientific German II,	3

Second Term.

(11)	Forest Utilization,	5
(7)	Silviculture,	6
(4)	Dendrology,	2
(24)	Zoology,	6
(29)	Soils,	5
(32)	Scientific German II,	3
(27)	Plant Chemistry,	2

SUMMER TERM—(12) Forest Mensuration.

Senior Year.

First Term.

(13)	Forest Finance,	3
(8)	Forest Protection,	6
(18)	Surveying,	8
(14)	Forest Management,	3
(30)	Economics, General,	5

Second Term.

(1)	Forest Economics and Policy,	3
(18)	Surveying,	8
(19)	Roads,	2
(14)	Forest Management (Working Plan),	4
(10)	Dendro-Pathology,	2
(17)	Mechanics—Telephone construction, etc.,	1
(9)	Forest Entomology,	2
(2)	Forest History,	1

FOREST UTILIZATION.
Forestry students lumbering.
Note economy in saw and low stumps.

SUMMER TERM—(18) Topographic Surveying and Thesis.

(1) FOREST ECONOMICS AND POLICY (Prof Ziegler), Senior Year—Second Term—3 hours.

Lectures with reference work. Taking up Forest Statistics—Resources, Production, Consumption, Exchange: Forest Policy—National Forests, Tariffs, Education: State Policy: Private Policy (Associations, etc.): Policy of foreign countries.

(2) FOREST HISTORY (Prof. Retan), Senior Year—Second Term—1 hour.

Lectures. Hstory of the development of the forestry idea in Pennsylvania. Contemporaneous development in the United States as a whole. Colonial conditions and laws, the early botanists, the primeval forests of the State, the beginnings of lumbering, its rise and fall, the "Fathers of Pennsylvania Forestry," the history of the State Forest Academy.

(3) ELEMENTARY FORESTRY (Prof. Illick), Freshman Year—First Term—Lectures 2 hours, Field Work 3 hours.

This course aims to lay a broad foundation for the later and more specific course in forestry. Special stress is laid upon the field work in the State forest of 25,000 acres adjoining the school. This State forest is considered the most instructive in Pennsylvania. Upon it are many plantations and improvement cuttings made within recent years. Each student is required to prepare a written report upon every field trip. This report is corrected and returned to him.

(4) DENDROLOGY, (Prof. Illick), Junior Year—First and Second Terms—Lectures 2 hours, Field Work 4 hours; Summer Term—Field Work.

The course in Dendrology extends throughout the entire junior year and covers both the systematic and biological aspects of trees. Special emphasis is laid on the species native to and commonly introduced into Pennsylvania. A more general study of the trees of the United States, especially those of commercial importance, is made in connection with the native species. The lectures are illustrated with fresh material, herbarium and museum specimens, photographs and lantern slides. Many of the dried specimens are mounted in Riker Specimen Mounts.

The field work of this course extends over the entire year. This is necessary in order to know the trees not only in their dormant or winter condition but also in the various stages of their active or summer condition. An afternoon of each week is given to field work and occasionally a long trip covers an entire day. The field work consists of pointing out the distinguishing characteristics and ecological factors of trees and of written tests on identification. The written test covers about 750 specimens each year. The woody flora about Mont Alto is very rich. It comprises over 150 species of trees and shrubs. Numerous ornamental trees and a small school arboretum are accessible.

A collection of winter twigs with buds mounted on cards and a key based on winter characteristics is required of each student. A complete library of books is accessible including Sargent's "Sylva of North America," 14 volumes, and Michaux's "North American Sylvia," 5 volumes.

(5) WOOD TECHNOLOGY AND TIMBER PHYSICS (Prof. Illick), Junior Year—First Term—Lectures 2 hours, Laboratory 2 hours, Work Room 2 hours.

The course covers the structural, physical, mechanical, and chemical properties of wood and the uses which are and could be made of the various species. The microscopic study of wood elements is done in the botanical laboratory. A room 16x61 feet contains the collection of woods of the important tree species of Pennsylvania and of some other species of commercial importance. This room is also used for practical work in wood identification. Bi-weekly tests are held in the workroom for identifying specimens of wood. Wood specimens are also included in the field test in dendrology. The workroom is equipped with work-benches and tools. A collection of Hough's "American Woods" is available.

(6) METEOROLOGY (Prof. Retan), Freshman Year—Second Term—4 hours.

The phenomena of the atmosphere, their explanation and the forecasting of the weather. United States weather maps are received and studied from day to day. Two experiment stations are maintained, one in the forest and one in the open, where daily reading of maximum-minimum thermometers and rain gauge readings are made by the students. Lectures and practical work in forest influences is given in connection with this course. Davis' Elementary Meteorology and Moore's Descriptive Meteorology are required.

(7) SILVICULTURE (Prof. Retan), Junior Year—Second Term—Lectures 3 hours, Field Work 3 hours.

Silvics; Forest Geography; Reproduction and Care of Forests, Planting, Sowing, and Nursery Practice, form the subdivisions of this course, the latter being the one most emphasized. Particular attention is given to Pennsylvania forest types and their treatment.

The practical work is very extensive and is not included under the three hours given to field work. Those hours are devoted to work in Silvics, trips being taken through the neighboring forests. In addition, in the spring, the class spends about two weeks each year in planting various species under a wide range of conditions. Later they go into the nursery and perform very operation throughout the season from planting seed to lifting and shipping seedlings under the direction of an experienced nurseryman. During the summer, the class also makes experimental cleanings and thinnings in the forest on typical areas. A large number of plantations and thinnings made in previous years are now yielding unexcelled material for the study of the effects of such operations on the characteristic types of the State.

The library is well stocked with the best works on the subject. Schlich, Schenck, and Mayr are the texts assigned for study.

(8) FOREST PROTECTION (Prof. Retan), Senior Year—First Term—Lectures 3 hours, Field Work 3 hours.

The course in Forest Protection is adapted to the conditions prevailing in the Pennsylvania forests. It does not include Entomology or Pathology. Emphasis is laid on the primary importance of the subject for Pennsylvania foresters. The grazing and the fire problems are taken up in detail and discussed from the standpoint of the differing conditions existing in the different parts of the State and also on the National Forests of the west. Methods of regulation and elimination, planning and working out a complete fire protective system, fire laws of the States, and protective measures and implements of other states are considered. Public education is discussed.

The field work consists of trips to this and neighboring forests for the study of the protective systems and the effects of grazing, fire, frost, heat, etc. In the nursery screens and mulches are experimented with. Numerous plantations are studied as illustrations of the effects of covers of various heights. Practical experience in telephone construction is given in another course. (See "Mechanics".)

FOREST ACADEMY SAW MILL.
Used in the Forest Utilization and Forest Mensuration Courses.

As the student body fights all the fires which occur in this forest they get practical training in this work throughout the three years of the course. The junior and senior classes are mounted to procure the highest efficiency in this respect. What is believed to be the first forest fire wagon built in the United States, with complete pack saddle equipment, is available.

(9) FOREST ENTOMOLOGY (Prof. Adams), Senior Year—Second Term—Lectures 2 hours.

The anatomy, physiology, development, and classification of insects; the life histories of both beneficial and injurious species, with special reference to those forms which are of economic importance in the forest.

(10) DENDRO-PATHOLOGY (Prof. Illick), Senior Year—Second Term—Lecture 1 hour, Field Work and Laboratory 2 hours.

This course considers some of the diseases of trees caused by cryptogamic parasites and parasitic flowering plants. The nature and life history of representatives of the principal classes are considered together with practicable preventive and remedial measures for checking their damage. The lectures are illustrated with photographs, lantern slides, and museum specimens. The museum collection comprises many of our common timber diseases and some foreign ones. Lectures are supplemented by field work in the State forest adjoining the school and in the school nursery.

(11) FOREST UTILIZATION (Prof. Illick), Junior Year—Second Term—5 hours.

The work of this course is based on Schenck's "Forest Utilization." Special reference is given to methods of utilization applicable to the State of Pennsylvania, but the methods used in other parts of the United States and in Germany are also considered. The course comprises not only school training but also practical experience in logging and lumber manufacture. Each student actually works at all operations from the marking of the trees for felling until the converted material is stacked in the lumber yard in the form of boards or dimension stock. A school saw mill together with a lath and shingle mill afford an excellent opportunity for practical instruction. Nearby woodworking plants are visited. Bi-weekly seminars are held at which students are required to present abstracts of current lumbering journals.

(12) FOREST MENSURATION (Prof. Illick), Junior Year.

The major part of the time of the months of June, July, and August, of the junior year are devoted to lectures, quizzes, written tests, compilation of field data and field work in Forest Mensuration. This course aims to lay a foundation for Forest Management. It is based on the texts of Graves and Schenck. Commercial and scientific methods of determining contents of felled trees and standing trees are considered. It also considers log rules and their application, the scaling of logs, increment, volume tables, yield tables, form factors, estimating mill factors, etc. A school saw mill is available to aid in working out some of the data. A portion of the time is spent in collecting data in the adjoining State forest for a stock survey and for a working plan.

(13) FOREST FINANCE (Prof. Ziegler), Senior Year—First Term—3 hours.

Lectures: Formulae—Compound Interest, Annuities, Periodic Payments, Discount; Comparison of Receipts and Expenses; Forest Valuation; Calculating Forest Damage; Annual Charges; Forest Taxation; Finance Problems.

FORESTRY STUDENTS ON A DENDROLOGY FIELD TRIP.
Identifying trees by buds when leaves are off.

(14) FOREST MANAGEMENT (Prof. Illick), Senior Year—First and Second Terms—Lectures 2 hours, Field Work 2 hours.

Separate courses are given in Forest Management and Forest Finance so Forest Management is considered in a narrower sense and includes Organization, Administration, and Formulation of Working Plans. Special consideration is given to the normal forest, increment, growing stock, gradation of age classes, sylvicultural systems of managemnt, rotation, regulation, and distribution of yield, and working plans. Each class makes a geometric, qualitative, and quantitative survey of a certain forest area and formulates a rational scheme of procedure for its development. In addition each year a portion of the State forest is divided into permanent managerial figures (compartments) and a complete survey made of it with reference to site quality, growing stock, yield, rotation, increment, age classes, etc.

(15) TRIGONOMETRY (Prof. Ziegler), Freshman Year—First Term—4 hours.

Course designed to cover trigonometric analysis, right and oblique triangles, and particularly the accurate use of logarithms and trigometric tables in the solution of problems.

Text—Elements of Trigonometry—Phillips and Strong.

(16) GENERAL PHYSICS (Prof. Netoffsky), Freshman Year—First and Second Terms—4 hours lectures and recitations.

A study of the fundamental principles of Physics and their application.

Equipment.

The physics equipment consists of a serviceable set of apparatus for demonstration purposes.

(17) MECHANICS (Prof. Netoffsky), Senior Year—Second Term—1 hour.

A study of the general principles of the construction and operation of machines, engines, boilers, telephone systems, and appliances that a forester has occasion to use. Visits of inspection to the neighboring manufacturing plants and engineering works are made during the term.

(18) SURVEYING—PLANE AND TOPOGRAPHIC, AND MAP DRAFTING (Prof. Ziegler), Senior Year—First and Second Terms—2 hours recitations, 6 hours drafting and field work followed by 10 weeks' summer work making topographic map of about 2,000 acres of forest land.

Includes compass surveying; levelling (spirit and barometric); plane-table and traverse-table work; stadia work; triangulation; practice in land surveying—particularly re-running old lines; testing tapes, transits, levels, etc.

Text—Plane Surveying—Tracy.

Equipment.

Two Randolph Mountain transits; one Young engineer's transit; one Gurley engineer's transit with gradienter; one plane-table with telescopic alidade with stadia equipment; two traverse boards; two 16 and 18 inch Wye levels; open sight compasses; barograph and aneroid barometers; standardized steel tape with spring balance attachment, etc.

Drafting equipment includes two wooden and one precision pantograph, polar planimeter, and blue-printing equipment.

(19) ROADS (Prof. Ziegler), Senior Year—Second Term—2 hours.

Lectures and field work (extra). History; traction principles; grades; drainage; purpose and location of forest roads; survey and laying out line; construction of dirt roads; construction of surfaced roads; costs. References. Field work includes survey in locating and staking out mountain road, grading, and drain work; also critical examination of modern mountain surfaced and dirt roads.

(20) BOTANY I. (STRUCTURE AND PHYSIOLOGY OF THE SPERMATOPHYTA.) (Prof. Adams), Freshman Year—First Term—Lectures 3 hours, Laboratory Work 3 hours.

A study of the seed-bearing plants, cell structure, tissue formation, and structure and functions of the root, stem, and leaf systems. This is followed by a discussion of the life processes of plants, as absorption, transpiration, conduction, photosynthesis, irritability.

(21) BOTANY II. (EVOLUTION OF THE PLANT KINGDOM.) (Prof. Adams), Freshman Year—Second Term—Lectures 3 hours, Laboratory or Field Work 3 hours.

A careful study of representative examples among the algae, fungi, liverworts, mosses, ferns and their allies, gymnosperms and angiosperms, with special emphasis on the form of plant parts, and a comparison of them in the different groups. Special attention is also given to the alternation of generations in the plants studied, and in working out their life histories the progression and retrogression of certain organs and phases in proceeding from the lower to the higher plants is noted.

(22) BOTANY III. (TAXONOMY.)—(Prof. Adams)—Freshman Year—Summer Term—Lectures 2 hours, Laboratory or Field Work 8 hours.

A comparative study is made of the families of flowering plants, and special training is given in the methods of collection and preservation of material. Each student is required to make an herbarium of at least 150 species of herbaceous plants, which are to be properly identified by means of Gray's New Manual of Botany.

Note:—Further work in the taxonomy of trees is given in the course in Dendrology.

(23) BOTANY IV. (PLANT ECOLOGY.)—(Prof. Adams)—Junior Year—First Term—Lectures 3 hours, Laboratory or Field Work 3 hours.

This course deals with the relation of plants to their environment. First, there is a study of the ecological factors, which in general are grouped under physical, climatic, and biotic factors. This is followed by a discussion of the struggle for existence among plants, the laws of migration, the analysis of vegetative forms and structures, plant formations and societies.

In the laboratory different members of the plant are studied as to their special functions and their relations to environment. The stem, root, leaf, flower, etc., are carefully examined and their ecological relations pointed out.

The Forest Academy is very favorably located for the study of Botany, as representative types of plant life may be found in the immediate vicinity of the school. Therefore students are able to work with fresh material which is a decided advantage over the studying of preserved or dried plants.

Equipment.

The equipment of the Botanical Laboratory consists of compound microscopes, each with high and low power objectives; dissecting microscopes; a complete set of charts; over 1,000 microscopic slides and a herbarium of over 3,000 specimens. An embedding oven and two microtomes offer facilities for the preparation of histological material.

IN THE BOTANICAL LABORATORY.

THE LIBRARY

(24) GENERAL ZOOLOGY (Prof. Adams)—Junior Year—Second Term—Lectures 3 hours, Laboratory or Field Work 3 hours.

A general survey of the animal kingdom showing the gradual development from the Protozoa to the Vertebrata. The structure, habits, and life history of animals typical of the various phyla are studied in the laboratory and in the field.

(25) CHEMISTRY I. (GENERAL INORGANIC)—(Prof. Netoffsky)—Freshman Year—Second Term—6 hours—Lectures, Recitations and Laboratory Work.

An elementary study of the elements, their history, occurrence, preparation, properties, and their principal compounds.

The course includes the theory, laws, practice in equation writing, and problems.

(26) CHEMISTRY II. (Continuation of CHEMISTRY I.)—(Prof. Netoffsky)—Junior Year—First Term—6 hours.

A study of the properties, reactions, separation, and recognition of the common elements and their compounds.

The last half of the term is devoted to the study of the carbon compounds.

(27) PLANT CHEMISTRY—(Prof. Netoffsky)—Junior Year—Second Term—2 hours. Lectures and Recitations.

A study of the chemistry of the plant, its food, growth, and products.

The course includes the chemistry involved in wood utilization industries.

Equipment.

The chemical laboratory, accommodating twelve students, is well equipped with working tables, a system of individual lockers, wall cases, water, reagents, balances, and the usual apparatus.

(28) GENERAL GEOLOGY—(Prof. Netoffsky)—Junior Year Second Term—4 hours. Lectures, Recitations, Laboratory, and Field Study.

A study of the fundamental principles and facts of Geology. The course includes a study of the common minerals and rocks.

Equipment.

The geology equipment comprises a collection of fossils, minerals, rocks, and ores. Numerous maps and charts of the United States Geological Survey and of the Pennsylvania Geological Surveys are available for study purposes.

(29) SOILS—(Prof. Netoffsky)—Junior Year—Second Term—5 hours. Lectures, Recitations, Laboratory, Nursery, and Field Study.

A study of the origin, formation, properties, and classification of soils. The laboratory work includes studies of the physical and chemical characteristics of soils from the nurseries, plantations, and forest stands.

The field work consists of soil mapping and the management of soil in the nurseries and in planting.

Equipment.

The soils laboratory is equipped with many types of apparatus for soil study, and is used in connection with the chemical laboratory.

(30) GENERAL ECONOMICS—(Prof. Ziegler)—Senior Year —First Term—5 hours.

An attempt to understand the principles of economics and their application to present conditions and problems. Extended reference work in other authors is required, and also the ex-

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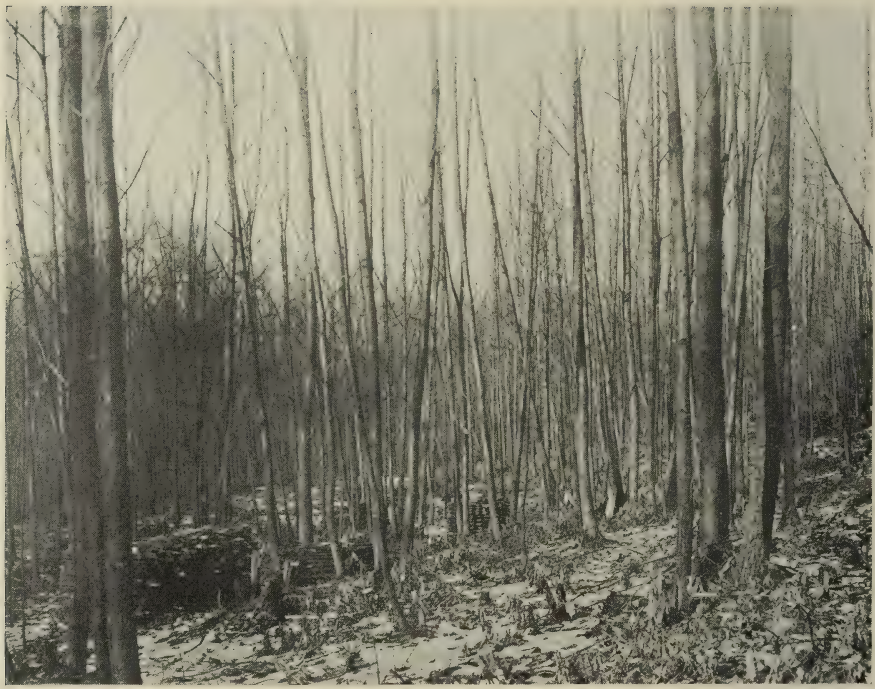

A YOUNG HARDWOOD SPROUT FOREST THINNED BY FOREST STUDENTS.
About 7 cords per acre of defective and suppressed material removed.

amination of current literature, particularly that relating to present governmental problems, most of which are economic in nature.

Text—The Elements of Economics—Bullock.

(31) GERMAN I. (Prof. Adams)—Freshman Year—First and Second Terms—3 hours.

Thomas' Practical German Grammar, Part I.

Translation of Bacon's "Im Vaterland."

(32) GERMAN II. (Prof. Adams)—Junior Year—First and Second Terms—3 hours.

First Term: Translation of Gore's "German Science Reader."

Second Term: Translation of Schwappach's "Forstwissenchaft."

(33) ENGLISH—(Prof. Retan)—Freshman Year—First and Second Terms—3 hours.

The course in English is designed to serve two ends. In the first place the student should be able to appreciate literature, Secondly, he should be able to express his thoughts clearly and well. Exercises are given in the formulation of reports and estimates. Weekly essays are written, based on the reading done and on the class room work. Speaking extemporaneously is encouraged. A Foresters' Club is maintained by the students at which debates and other literary exercises are required. Thoreau's "Walden" and Burke's "Conciliation" are the works studied critically.

(34) BUSINESS LAW AND BOOKKEEPING—(Prof. Retan)—Freshman Year—First Term—3 hours.

An elementary course in the principles of law as met with by the forester as a business man. White's "Business Law" is followed.

The system of bookkeeping used by the Department of Forestry is taught.

GRADUATES.

Since its formation, fifty-three men have been graduated from the Academy. Of these almost all are at present in the employ of the State Forestry Commission, either in charge of State forests, or in special work of the Department. One is in the United States Forest Service in the west, two are in private work, and one is deceased. To these names should be added that of Arthur Davis, class of 1908, who died while an undergraduate. The names of the graduates and the present address of each follows:—

Name	Class	Address.
Avery, John E.	1906	Notch, Pike Co., Pa.
Bastian, John A.	1909	Loyalsock, Lycoming Co., Pa.
Bietsch, Tom O.	1908	McAleveysfort, Huntingdon Co., Pa.
Bodine, Alfred W.	1910	Newton Hamilton, Mifflin Co., Pa.
Brock, Ralph E.	1906	West Chester, Chester Co., Pa.
Bryner, Harold E.	1908	New Germantown, Perry Co., Pa.
Byers, William L.	1906	Rainsburg, Bedford Co., Pa.
Conklin, Robert G.	1906	Fayetteville, R. D. No. 2, Franklin Co. Pa.
Conklin, W. Gardiner.	1908	Troxelville, Snyder Co., Pa.
Dague, William F.	1908	Clearfield, Clearfield Co., Pa.
Dutlinger, Forrest H.	1908	Westport, Clinton Co., Pa.
Elliott, Harry E.	1909	Sinnamahoning, Cameron Co., Pa.
Emerick, R. Lynn.	1909	Cross Fork, Potter Co., Pa.
Evans, Horace C.	1908	Waterville, Lycoming Co., Pa.
Evans, W. Boyd.	1912	Sizerville, Cameron Co., Pa.
Fox, P. Hartman.	1911	Austin, Potter Co., Pa.
Funk, Nathaniel B.	1912	Cross Fork, Potter Co., Pa.
Heintzleman, B. Frank.	1907	Portland Office, U. S. Forest Service, Oregon.
Hogentogler, Joseph R.	1912	Rosecrans, Clinton Co., Pa.
Houpt, W. Elmer.	1909	Aitch, Huntingdon Co., Pa .
Irvin, James A.	1912	Medix Run, Elk Co., Pa.
Jerald, Frank D.	1910	Slate Run, Lycoming Co., Pa.
Keller, John W.	1910	Lloyd, Tioga Co., Pa.
Kirk, Carl L .	1909	Penfield, Clearfield Co., Pa.
Kraft, William H.	1906	Deceased.
Ludwig, Walter D.	1910	Boalsburg, Center Co., Pa.

Name	Class	Address.
MacAvoy, John L.	1911	Ligonier, Westmoreland Co., Pa.
McNaughton, Nelson R.	1911	Karthaus, Clearfield Co., Pa.
McNeal, James E.	1907	Department of Forestry, Harrisburg, Pa.
Meek, Charles R.	1912	Coburn, Center Co., Pa.
Metzger, Homer S.	1909	Loganton, Clinton Co., Pa.
Miner, Clement C.	1910	Middlebury, R. D. No. 3, Tioga Co., Pa.
Morton, T. Roy.	1908	Petersburg, Huntingdon Co., Pa.
Mueller, Harry J.	1909	Bellefonte, R. D. No. 2, Center Co., Pa.
Mulford, Paul H.	1907	Asaph, Tioga Co., Pa.
Mumma, Walter M.	1911	North Bend, Clinton Co., Pa.
Mustin, Maurice.	1912	Department of Forestry, Harrisburg, Pa.
Retan, George A.	1909	Mont Alto, Franklin Co., Pa.
Robinson, Milton O.	1912	Canadensis, R. D. No. 1, Monroe Co., Pa.
Rupp, Alfred E.	1909	Fort Loudon, Franklin Co., Pa.
Ryon, James B.	1912	Glen Union, Clinton Co., Pa.
Seltzer, John W.	1909	Orwigsburg, Pa.
Sheeler, George W.	1912	Snow Shoe, Center Co., Pa.
Smith, Edgar H.	1911	Elimsport, Lycoming Co., Pa.
Staley, Lewis E.	1906	Mount Alto, Franklin Co., Pa.
Strobeck, John L.	1909	Cresco, Monroe Co., Pa.
Thomson, Harry A.	1909	Slate Run, Lycoming Co., Pa.
Vail, H. Lawrence.	1910	Conrad, Potter Co., Pa.
Warfield, D. Kerr.	1910	Milroy, Mifflin Co., Pa.
Wells, Arthur B.	1911	Fields Station, Lycoming Co., Pa.
Williams, John R.	1909	Pine Grove Furnace, Cumberland Co., Pa.
Winter, Raymond B.	1910	Mifflinburg, R. D. No. 2, Union Co. Pa.
Witherow, John L.	1907	East Waterford, Juniata Co., Pa.

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Bulletin No. 9. April, 1914.

Commonwealth of Pennsylvania

DEPARTMENT OF FORESTRY

ROBERT S. CONKLIN, Commissioner of Forestry
in Cooperation With the
Forest Service, U. S. Department of Agriculture
HENRY S. GRAVES, Forester

Wood-Using Industries

OF PENNSYLVANIA

By ROGER E. SIMMONS,
United States Forest Service,
1912.

HARRISBURG, PA.:
WM. STANLEY RAY, STATE PRINTER
1914

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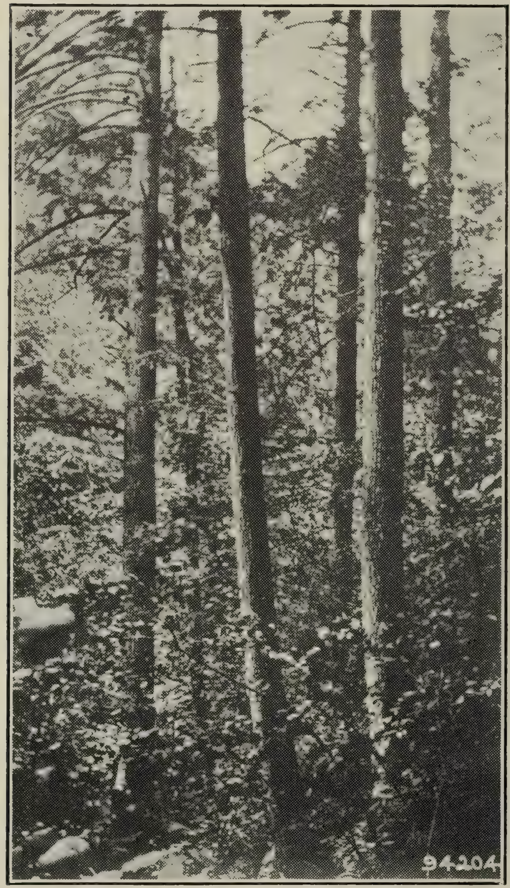

Fig. 1.—Virgin hemlock mixed with white pine in the Jack's Mountain Division of the Seven Mountains' State Forest. Shows types which Pennsylvania did and can produce.

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NOTICE

The study upon which this report is based was undertaken by the Department of Forestry of Pennsylvania in cooperation with the United States Forest Service, the work being done under the direction of Robert S. Conklin, Commissioner of Forestry of Pennsylvania, and O. T. Swan, in charge Office of Industrial Investigations, United States Department of Agriculture. The statistics were compiled from data collected in the summer of 1912, covering a period of one year from July 1, 1911 to June 30, 1912, inclusive.

ACKNOWLEDGEMENT

In the preparation of the text of the Pennsylvania Wood-Using Industry Report, the Forest Service desires to acknowledge the kind assistance of Hon. I. C. Williams, Deputy Commissioner of Forestry, Harrisburg, Pennsylvania, and Mr. John L. Strobeck, Forester; also of Foresters James E. McNeal, W. Gardiner Conklin, R. Lynn Emerick, and Walter D. Ludwig, of Pennsylvania, Department of Forestry, who assisted in the actual collection of data.

WOOD-USING INDUSTRIES OF PENNSYLVANIA

INTRODUCTION.

In the work of practical forestry, Pennsylvania is a leading State and bears this distinction as a result of the development and operation of an effective State-wide policy. To this Commonwealth also properly belongs the credit of being the cradle of American forestry. When William Penn made the well known provision in the Charter of Rights, that for every five acres cleared one should be left in woods, the seed of forestry was first sown. Following this, as early as 1700, the proprietary Government enacted forest fire laws, and from that time to the present, State Legislatures have debated upon and passed similar enactments. Popular sentiment favoring the practice of forestry by the State, grew steadily from the beginning, but in the past 20 years it has developed with remarkable rapidity. Directing this educational propaganda were men who have since gained prominence and who stand high among those recognized as authorities pertaining to forestry subjects.

Naturally, much has been written and said on all phases of forest conservation and improvement in Pennsylvania. In the discussions, the economic importance of forests, aside from the collateral values they are regarded as possessing, has been reckoned usually in terms of production of the rougher forest products, such as lumber, lath, shingles, crossties, cooperage stock, telegraph poles, fence posts, mine timbers, cordwood for fuel and distillation purposes. The commercial gain that comes to the State through the millions of feet of lumber that the forests supply through their conversion into such finished commodities as vehicles, boxes, handles, novelties, has always been recognized; but reference thereto has been made only in a casual manner as the detailed data have not heretofore been available. It is a well established fact that the cutting and shipping away of lumber and other forest materials like pulp wood, cooperage stock, chemical wood, etc., is not as permanent a commercial and industrial gain as when those materials find a home market and are held for the manufacture of finished articles within the State, but to what extent this development has taken place in Pennsylvania, no previous investigation has ever attempted to ascertain. This study has been projected, therefore, with this special view, and of outlining the relations of the wood-consuming industries to the growing forests, as well as of collecting information respecting wood uses and factory waste.

The information presented in this report covers the period of twelve months, prior to July, 1912. It was gathered in the late summer and fall of that year by the Department of Forestry of Pennsylvania, and by the Forest Service, United States Department of Agriculture, working under a cooperative agreement. The information was solicited from the manufacturers, not only from those producing complete wooden commodities, but from those making wooden parts of products, axe handles, brush blocks, and piano cases, for example; those factories that use lumber as a means of manufacturing other commodities, like patterns and flasks in foundry work, and factories of all kinds that require lumber in the marketing of their wares by manufacturing their own boxes and crates. The names and locations of all manufacturers were obtained through the assistance of the postmasters in the

State, and the thoroughness and accuracy of this report were made possible by the kind co-operation of the wood users in giving detailed information as to their individual operations. Report blanks were mailed to each, with the request that they be filled in and returned. After a time, agents representing Pennsylvania and the Federal Government were sent throughout the State to visit factories which had failed to report, and more particularly to study at close range processes of manufacture, waste problems, and industrial conditions. On completion of the field work, in accordance with agreement, the data were compiled and the report written by the office of Industrial Investigations of the Forest Service, whereupon the manuscript was turned over to the Pennsylvania Department of Forestry for revision and publication.

For a number of years the Federal Government has kept a record of the annual production of rough lumber and other forest products by States, and for the last seventeen years the State has been gathering similar statistics for Pennsylvania. These reports should not be confused with the present investigation, which in no way concerns the output of sawmills, except in a supplemental capacity. This investigation relates to the rough lumber after it leaves the sawmills and to the bolts and billets after they leave the woods, tracing them through different channels into commodities of final manufacture. It is not the purpose of this study to record the total quantity of wood used annually in the State. Much of it, in the form of rough lumber, goes into construction, which needs no other change than cutting or trimming the timbers, planks, or boards, to fit them into place in the house, bridge, tunnel, concrete forms, scaffolding, fences, etc. This material has not been taken into account and neither have the large quantities of dressed lumber which are brought into the State in the form of flooring, siding and ceiling, finished and ready for use. In addition there are parts of products made in other states and sent into Pennsylvania merely to be assembled; vehicle parts and box shooks are examples; also there are commodities partly manufactured, like club turned handles, spokes, rough bobbins and speeders, chair stock, etc., that have not been included in Pennsylvania but accredited to states in which the principal operations that change the forest material into the finished articles occur.

PURPOSE OF THE STUDY.

The Pennsylvania investigation has been conducted under the same plan as that followed by the Forest Service in 30 other states. Eventually, the information from all the states will be correlated in a national study and a series of publications issued by the Federal Government relating to the wood-using industries and the commercial woods of the United States.

Every factory was asked to state the amount of each species used, the commodity into which each was made, the form in which it was received, and whether these woods came from within Pennsylvania or from outside the State. Inquiries referred also to tendencies of manufacture, closer utilization, and methods followed for waste utilization. As stated above, no data were solicited from sawmills or those producing veneer, laths, shingles, crossties, cooperage, stock, posts, telegraph poles, chemical wood, pulp wood, etc. This information for all the States has been kept and reported annually by the Bureau of the Census, and such of these statistics as relate to Pennsylvania, appear in the appendix of this report; they were taken from the census bulletins issued for 1911-1912. Apart from the concerns producing the above named rough forest products, there are scattered throughout Pennsylvania nearly 5,100 factories that take wood and convert it into articles of final form. These have been separated into classes or industries, and as much as possible of the data which they represent has been similarly arranged and is presented in this report in tabular form.

The question of the disposal of that part of the rough lumber cut going into the various channels of manufacturer is answered by this report and by the others of this series. For instance, the furniture woods are grouped together in the order of their importance as to amount consumed and in the same way is presented the species demanded for the making of other chief commodities, like chairs, vehicles, refrigerators, matches, farm implements, sporting goods, etc.

The Pennsylvania Department of Forestry and the United States Forest Service are constantly receiving inquiries from points throughout this and nearby states concerning markets for various kinds of timber and lumber, and are called on for data on practical uses of wood and for suggestions and advice on possible solutions of waste problems. This report will answer many of these questions. The farmer, the timber owner, and the sawmill man are aided in selling their material by having the information of the kinds of wood the manufacturers demand and of the forms and prices applying to their purchase. The manufacturers in turn are benefited in these added opportunities for buying raw material and in the suggestions offered for finding in the waste of another factory suitable materials for making their own wares. The report may also suggest to manufacturers possible substitutes of cheaper woods for the more costly ones that are being used, besides pointing out the chief regional sources from which the industries procure their raw material. Dealers in wooden products throughout the country can learn what the Pennsylvania manufacturers have to sell, while those outside of Pennsylvania who desire to dispose of their lumber or wood in other forms can find what the manufacturers demand.

To illustrate the use of this bulletin for reference, suppose information is requested concerning the raw material the handle makers demand. On page 96 appears Table 59, giving the list of handle woods, the prices and amounts of each, and other pertinent information, while in the directory appended to this report, grouped also by industries, appear the names and addresses of the handle manufacturers buying these woods, page 186. Again, suppose information is needed as to what uses are made of ash, with a view of selling to the best advantage. By first turning to the list of uses on pages 145, 146, one can find all commodities made in the State for which the manufacturers demand ash. Should interest be attracted to the use of this wood in the form of lumber, say for passenger cars, by means of the table of contents the industry table embracing prices f. o. b. factory and other data referring to car building material is quickly found. Then by turning to the names of car builders in the directory, all preliminary information is at hand relating to the conditions of marketing this material with the factories engaged in the industry.

FOREST CONDITIONS.

The earliest settlements were naturally in the hardwood regions of the eastern part of the State, where were found extensive forests of various species of oak and hickory. Chestnut, yellow poplar, black walnut, elm, white ash, basswood, and other valuable trees were also common and often attained large size. In the southern tier of counties were magnificent forests, mostly of deciduous growth similar to those in the eastern part of the State. Probably in no region of the United States were there finer hardwoods than here, and magnificent specimens still standing confirm this presumption and make one realize the almost inconceivable wealth Pennsylvania had in her timber lands. West of the Allegheny River the prevailing timber was largely hardwoods, similar to those in eastern Pennsylvania; but in the central and northeastern parts of the State, in the mountains, is the home of the cone bearing trees, the pine and the hemlock. With these, especially in the northern counties, were associated beech, birches, sugar maple, ashes, the black cherry, and scattered stands of other hardwoods. At first there was an exceedingly limited market for timber, and the gigantic trees that constituted the forests proved a hindrance rather than an asset. The same destructive method of cutting them and rolling the logs together to be burned was pursued in Pennsylvania, with the same zest as in other timbered states. Even the older living citizens recollect the custom of removing timber by fire from ground which was to be used for agricultural pursuits. Farm land was needed above all, but the unabated desire to clear away the timber was not limited to areas suitable for cropping but was extended into thousands of acres that have since been abandoned, after being denuded, as unsuitable for profitable farming.

In the days of the early settlers of Pennsylvania, there was practically no market for hardwoods aside from what was required for local use. In comparison with the demand for softwoods to meet the needs for buildings and other structural purposes, the call for hardwoods was very limited. White pine was then regarded as the principal and only desirable lumber, and was the first in demand when the exploitation of the Pennsylvania forests began. Large rafts of pine logs were floated down the Susquehanna River and its tributaries as these streams drained a region abounding in the growth of this wood. About this period, large quantities of timber were sacrificed for the bark, which was peeled for tanning purposes; the logs being left in the woods to rot and burn. Not long after eastern woods had begun to be felled, similar activities were started in the forests of the far western part of the State. Here the Allegheny and Monongahela Rivers afforded the means of rafting large quantities of timber from that part, which, after being manufactured into lumber, was taken to market by water through the Ohio and Mississippi Rivers. The introduction of railroads extended the lumber industry inland, remote from the rivers, where the finest developed stands of conifers and hardwoods were abundant. After the great demand for white pine had considerably increased its price, hemlock began to attract attention. Though at first considered an inferior lumber, this prejudice soon faded away and Pennsylvania was destined to meet a constantly increasing demand for this species and has since been among the three States leading in hemlock products.

The marketing of the stands of magnificent hardwood forests which had to give way to provide room for agriculture and homes for farmers, was for many years an important economic problem in this State. There was little demand for this kind of timber abroad and still less in any of the other States. This presented the situation that if the hardwoods were to be exploited at all, it would be necessary to develop a market at home, by the establishment of factories like those concerned in this report, which would consume this material for making various manufactured products. These wood-working industries though prosperous, developed gradually at the outset. Later they not only rapidly increased in number, but grew to substantial proportions and contributed largely to the industrial expansion which gave Pennsylvania probably her early recognition as one of the leading manufacturing states. The products turned out by these industries not only found markets in other states, but were demanded as important articles for export to European cities.

IMPORTANCE OF MANUFACTURING.

Besides the forests, the other natural resources of the State—coal, petroleum, gas, ore, stone, clay, and rich productive soil—have also influenced the starting and growth of particular industries. These resources, with the further advantages Pennsylvania offers through its harbors and waterways, and a network of railway systems, making raw material accessible and products easily marketed, have gained for Pennsylvania a commercial prestige surpassed by only one other state.

In the report of the 13th Census, taken in 1910, the Federal Government shows the valuable farm products taken from Pennsylvania in 1909 to approximate nearly 166¾ million dollars; the value of mineral products, including the output of mines, wells, and quarries, amounted to 226½ million dollars; while for the same period the factories, 27,563 in number, gave an added value to raw material of nearly 1½ billions dollars. Manufacturing then is preeminently the first of Pennsylvania industries.

The wood-using industries, with which this report deals, constitute one of the important classes of the State's manufacturing enterprises. The value of the commodities turned out by them, together with that of the rough forest products produced, such as crossties, telegraph poles, etc., annually approximate $100,000,000. Although this is small compared to the production of factories using iron and steel, it is next in importance and indicates clearly the part that forests and their affiliated industries have and are still taking in the commercial development of the State. The capitalization of these wood factories amounts to over $63,000,000, and they give employment to nearly 100,000 wage earners, many of whom are skilled mechanics. It is known that the continued operation of these industries depends upon the future timber supply. And equally obvious is the fact that if these factories have to shut down and move closer to other timber producing regions, the result will be general industrial depression and loss.

FUTURE TIMBER SUPPLY.

For more than fifty years lumbering has been actively carried on in Pennsylvania, and has been especially active for the past twenty-five years. Valuable scattered tracts of old growth hemlock and hardwood timber are still to be found in the State, but they represent only a small percentage of its wooded area and before many years pass they will be consumed. It is, therefore, recognized that the second-growth forests will have to be depended upon to meet the demands of the manufacturer, and this can only be made possible by the practice of forestry, according to a definite State-wide policy similar to that which this State has already inaugurated.

Studies by the Pennsylvania Department of Forestry of forest conditions in the State, have pointed out vast areas like that contained in the State forests already established, that are better suited to forest growth than for agriculture. A large portion of these areas has a forest cover of valuable young trees in situations most conducive to their rapid growth. By the same practical and systematic management which is now being followed on the established forests, all of these lands can probably not only maintain the present lumber output of the State, but increase the production in a comparatively short time. In other words, the State, by looking to the future timber supply, can continue her three fold industry of growing timber, cutting it into lumber, and making it into commodities.

SCOPE OF THE STUDY.

This report is divided into three parts. Part I relates to the species of wood used by the wood-working factories in Pennsylvania, independent of their particular uses and the factories purchasing them. There is a general discussion of each wood, its range, and importance in the State as a lumber tree, the proportion of the amount used grown within the State, and a brief though particular enumeration of the properties of the wood. Uses are referred to only in a general sense by calling attention to the industries reporting the wood in large quantities.

Part II concerns the wood-using factories of Pennsylvania which have been divided into industries according to products manufactured. Following this is a discussion of individual industries, referring to the products manufactured, processes of manufacturing, woods demanded, and the principal qualities determining their use. In a majority of cases, the most suitable wood for each particular purpose is known, but the second best of the available kinds is pointed out where possible, and in this way, as well as in others previously mentioned, the report will prove valuable to wood users.

Part III is a summary of wood uses, independent of any industry classification or statistical data. In compiling this list, the Forest Service endeavored to arrange it to include every wooden commodity manufactured in Pennsylvania. It constitutes the most nearly complete compendium of uses of wood that has ever been arranged, and will be of particular value for reference. Part III further includes the directory of the names and addresses of manufacturers, grouped according to industries, who supplied the information contained in this report. The appendix presents data pertaining to Pennsylvania taken from reports of the Bureau of Census, United States Department of Commerce.

PART I.

KINDS OF WOOD.

A summary of the kinds of wood consumed in Pennsylvania manufacture, together with the cost, total quantity, and average price are presented in Table I following. Seventy-two kinds of wood were used within the State in the year 1911-12. White pine heads the list, representing nearly 14½% of the total, but had longleaf, loblolly, and shortleaf pine been grouped under the term "southern yellow pine" it would have stood first in the list, and in amount equal to more than ¼ of the total consumption.

It is interesting to know that the consumption of lumber in Pennsylvania exceeds the production. In 1912 the lumber cut by the State was 992,180,000 feet while the quantity consumed by the wood-using factories was 1,114,000,000 feet. Of the quantity used, 313,683,000 feet or 28% was accredited to the State, leaving 800,536,000 feet as coming from the forests of other States and from foreign countries. Cost is the principal consideration with the manufacturer purchasing raw material and the fact that his own State produces the same kind of lumber that he uses is of little consideration unless that material be the cheapest and readily and conveniently procured. That only a little more than one-fourth of the State's lumber production is consumed in factories within the State suggests a probable duplication in distribution that does not tend to economy. This condition is worthy of consideration by both lumber consumers and lumber producers, and when generally understood, can, through the medium of the regular trade agencies, be considerably improved.

So far as possible in this study, the data were presented by species rather than by genus in order to enable one more easily to study uses according to inherent properties. It is of far greater value to know that a wood is white oak, yellow poplar, or sugar maple than to have merely the generic name, oak, poplar, or maple. Owing to the many difficulties encountered this effort was but partially successful and was followed only to the extent warranted by the information furnished by the manufacturers and by general information as the particular uses of woods or the location where they were cut.

The southern states, and next to them the Lake states, contribute more of the shipped-in material than any other lumber producing region. Shipments of white pine, sugar maple, beech, birch, ash and elm were reported as originating in the Lake region. The largest part of the shipped-in supply of oak, yellow poplar, hickory, chestnut, and sycamore came from the forests of West Virginia, Maryland, Kentucky, and Tennessee, included within the hardwood region. Canada contributed a larger amount of wood but not as many kinds as the region embracing New York and the New England states, while the Pacific coast states sent a supply of six woods that aggregated nearly 10,000,000 feet. That such a large amount should have been brought over so great a distance to meet the demands of the Pennsylvania wood-users is significant of the growing scarcity of native eastern soft-woods.

Table 1.—Summary of kinds of wood used in Pennsylvania, year ending June, 1912.

Kind of Wood.		Quantity Used.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.
Common Name.	Botanical Name.	Feet b. m.	Per cent.		
White pine,	*Pinus Strobus*	160,749,759	14.43	$31 55	$5,071,607
Shortleaf pine,	*Pinus echinata,*	149,744,213	13.44	23 34	3,494,950
Longleaf pine,	*Pinus palustris,*	108,577,308	9.75	31 71	3,443,246
White oak,	*Quercus alba,*	98,190,060	8.81	34 00	3,338,005
Red oak,	*Quercus rubra,*	83,837,570	7.52	30 94	2,593,836
Yellow poplar,	*Liriodendron tulipifera,*	56,720,991	5.09	32 62	1,850,151
Sugar maple,	*Acer saccharum,*	54,955,805	4.93	22 29	1,225,049
Chestnut,	*Castanea dentata,*	51,326,097	4.61	25 22	1,294,609
Loblolly pine,	*Pinus taeda,*	51,241,544	4.60	19 91	1,020,167
Hemlock,	*Tsuga canadensis,*	43,027,872	3.86	20 60	886,201
Beech,	*Fagus atropunicea (F. grandifolia).*	40,244,300	3.61	17 42	701,244
Cypress (bald),	*Taxodium distichum,*	23,195,290	2.08	38 94	903,285
Red gum,	*Liquidambar styraciflua,*	22,865,144	2.05	22 78	520,842
Spruce,	*Picea* species,	20,539,028	1.84	21 34	438,216
Basswood,	*Tilia americana,*	18,698,836	1.68	29 53	552,118
Birch,	*Betula* species,	18,635,582	1.67	28 05	522,774
Hickory,	*Hicoria* species=(*Carya* species)	17,853,255	1.60	40 59	724,635
Ash,	*Fraxinus* species,	14,304,627	1.28	44 02	629,752
Pitch pine,	*Pinus rigida,*	10,630,700	.95	18 07	192,084
White elm,	*Ulmus americana,*	9,708,643	.87	27 61	268,014
Cottonwood,	*Populus deltoides,*	6,335,850	.57	26 66	168,938
Cotton gum,	*Nyssa aquatica,*	5,957,687	.54	32 29	192,350
Spanish cedar,	*Cedrela odorata,*	5,812,660	.52	112 93	656,435
Red and silver maple,	*Acer rubrum and Acer saccharinum.*	5,711,275	.51	21 66	123,690
Black gum,	*Nyssa sylvatica,*	4,957,160	.45	19 35	95,923
Southern white cedar,	*Chamaecyparis thyoides,*	3,737,300	.34	41 74	155,986
Mahogany,	*Swietenia mahagoni,*	3,680,254	.33	122 29	450,064
Douglas fir,	*Pseudotsuga taxifolia,*	3 364,138	.30	43 19	145,296
Western white pine,	*Pinus monticola,*	3,070,500	.28	40 22	123,496
Cherry (black),	*Prunus serotina,*	2,723,493	.24	39 73	108,191
Scrub pine,	*Pinus virginiana,*	2,386,095	.21	19 10	45,557
Norway pine,	*Pinus resinosa,*	2,327,340	.21	28 74	66,897
Sugar pine,	*Pinus lambertiana,*	1,213,700	.11	50 53	61,323
Red cedar,	*Juniperus virginiana,*	878,500	.08	56 29	49,454
Western yellow pine,	*Pinus ponderosa,*	830,000	.07	26 06	21,630
Black walnut,	*Juglans nigra,*	782,615	.07	72 94	57,085
Sycamore,	*Platanus occidentalis,*	697,073	.06	28 73	20,030
Cork elm,	*Ulmus racemosa,*	672,200	.06	32 88	22,102
Hornbeam,	*Ostrya virginiana,*	547,184	.05	43 83	23,985
Locust (black),	*Robinia pseudacacia=(R. Pseudo-Acacia).*	505,850	.05	22 93	11,601
Redwood,	*Sequoia sempervirens,*	505,682	.05	50 36	25,464
Western hemlock,	*Tsuga heterophylla,*	500,000	.05	20 00	10,000
Cucumber,	*Magnolia acuminata,*	351,400	.03	24 73	8,691
Yellow buckeye,	*Aesculus octandra,*	324,200	.03	25 19	8,168
Applewood,	*Pyrus* species,	172,435	.02	48 84	8,422
Dogwood,	*Cornus florida,*	164,137	.01	22 59	3,708
Ebony,	*Diospyros* species,	134,777	.01	188 18	25,363
Persimmon,	*Diospyros virginiana,*	113,010	.01	58 92	6,659
Circassian walnut,	*Juglans regia,*	108,140	.01	340 45	36,816
Butternut,	*Juglans cinerea,*	86,810	.01	33 72	2,927
French briar,	*Erica* species,	81,800	.01	351 34	28,740
Teak,	*Tectona grandis,*	65,590	.01	191 95	12,590
Holly (American),	*Ilex opaca,*	61,000	.01	99 10	6,045
Congo,	*Diospyros* species,	60,000	.01	133 00	8,000
Western red cedar,	*Thuja plicata,*	55,000	.01	39 09	2,150

Table 1.—Summary of kinds of wood used in Pennsylvania, year ending June, 1912—Continued.

Kind of Wood.		Quantity Used.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.
Common Name.	Botanical Name.	Feet b. m.	Per cent.		
Tamarack,	*Larix laricina,*	40,300	*	28 81	1,161
Balsam fir,	*Abies balsamea,*	40,000	*	45 50	1,820
Boxwood,	*Tabebuia pentaphylla and Buxus sempervirens*	32,416	*	298 90	9,689
Aspen (popple),	*Populus tremuloides,*	30,000	*	15 00	450
Willow (black),	*Salix nigra,*	25,000	*	13 00	325
Sitka spruce,	*Picea sitchensis*	15,000	*	35 40	531
Rosewood,	*Dalbergia* species,	6,185	*	462 89	2,863
Eucalyptus,	*Eucalyptus* species,	5,000	*	260 00	1,300
Lignum-vitae,	*Guajacum officinale,*	2,050	*	175 61	360
Mountain laurel,	*Kalmia latifolia,*	1,000	*	40 00	40
Sumach,	*Rhus hirta (R. typhina),*	500	*	80 00	40
Olive wood,	*Olea europea,*	480	*	81 25	39
Satinwood,	*Chloroxylon swietenia,*	120	*	200 00	24
Sassafras,	*Sassafras sassafras (S variifolium).*	50	*	25 00	1
Weichsel roots,	*Prunus mahaleb,*	30	*	540 00	16
Sarbo,		30	*	200 00	6
Doncella,	*Byrsonima spicata,*	10	*	100 00	1
Total,		1,114,219,650	100.00	$29 15	$32,483,227

Reeds,	24,000 lbs.
Rattan,	2,000 lbs.

*Less than 1-100 of 1 per cent.

Under the heading "Kind of Wood" the above table shows two separate lists of names. In the first column appear the names of the several woods as they are known to the trade, called common names. The scientific names which the botanists use to distinguish species are shown in the second column. In this and similar State reports, it has been the purpose of the Forest Service to call woods by their proper name with a view of standardizing nomenclature. Common names vary considerably according to locality but botanists as a rule are in agreement as to the scientific names. There are exceptions to this and among those shown in the above table are hickory, beech, locust, and sassafras. It will be noted that two botanical names are given for these woods. The first set is used by the Forest Service as given in the publication issued by the Federal Government entitled "The Check List of the Forest Trees of the United States." The second set is from the seventh edition of Gray's Botany which is used as a standard by the Pennsylvania Department of Forestry.

Thirteen of the species shown in the above table are foreign woods, the most prominent being Spanish cedar, and mahogany, followed by ebony and teak. Those accustomed to purchasing foreign woods in the form of logs, flitches, or lumber may regard the average cost of these woods as excessive. This is because a part of the supply of these woods is purchased in the form of thin veneer which, in order to be included in the tables of this report, was reduced to feet board measure with no allowance for waste or the cost of production.

THE WOODS GROWN IN PENNSYLVANIA.

Of the seventy-two woods which the manufacturers reported using, the entire amount of only six was home grown. These were aspen, (or popple), mountain laurel, sometimes called kalmia, black locust, sassafras, sumach and willow. The forests in the State also furnished a part of the supply of thirty-six other woods, making an aggregate of State-grown material used equal to a little more than 28% of the total consumption.

Instead of arranging the woods in the order of the quantity consumed, as in Table 1, they are shown in Table 2 alphabetically according to their generic names. This arrangement throws together consecutively the birches, the cedars, the oaks, the maples, and the pines, and allows an easy comparison of amounts of each species used, and if desired, an aggregate of any of them can be made readily. For a more convenient comparison of the home-grown woods with those grown out of the State, not only the quantities of these two classes are given for each species but also the per cent. which each class represents.

Table 2.—Summary of State-grown and shipped-in wood used in Pennsylvania, year ending June, 1912.

Kind of Wood.	Grown in Pennsylvania.		Grown Out of Pennsylvania.		Total.
	Quantity Feet b. m.	Per cent	Quantity Feet b. m.	Per cent.	
Applewood,	87,435	50.71	85,000	49.29	172,435
Ash,	6,568,952	45.92	7,735,675	54.08	14,304,627
Aspen (popple),	30,000	100.00	....	....	30,000
Balsam fir,	....	....	40,000	100.00	40,000
Basswood,	7,933,764	42.43	10,765,072	57.57	18,698,836
Beech,	27,556,900	68.47	12,687,400	31.53	40,244,300
Birch,	9,826,614	52.73	8,808,968	47.27	18,635,582
Boxwood,	....	....	32,416	100.00	32,416
Buckeye, yellow,	184,000	56.76	140,200	43.24	324,200
Butternut,	79,500	91.58	7,310	8.42	86,810
Cedar, red,	17,500	1.99	861,000	98.01	878,500
Cedar, southern white,	....	....	3,737,300	100.00	3,737,300
Cedar, western red,	....	....	55,000	100.00	55,000
Cherry, black,	1,802,880	66.20	920,613	33.80	2,723,493
Chestnut,	22,479,333	43.80	28,846,764	56.20	51,326,097
Congo,	....	....	60,000	100.00	60,000
Cottonwood,	88,500	1.40	6,247,350	98.60	6,335,850
Cucumber,	235,600	67.05	115,800	32.95	351,400
Cypress (bald),	....	....	23,195,290	100.00	23,195,290
Dogwood,	140,122	85.37	24,015	14.63	164,137
Doncella,	....	....	10	100.00	10
Douglas fir,	....	....	3,364,138	100.00	3,364,138
Ebony,	....	....	134,777	100.00	134,777
Elm, cork,	154,600	23.00	517,600	77.00	672,200
Elm, white,	846,300	8.72	8,862,343	91.28	9,708,643
Eucalyptus,	....	....	5,000	100.00	5,000
French briar,	....	....	81,800	100.00	81,800
Gum, black,	272,716	5.50	4,684,444	94.50	4,957,160
Gum, cotton,	....	....	5,957,687	100.00	5,957,687
Hemlock,	31,217,942	72.55	11,809,930	27.45	43,027,872
Hemlock, western,	....	....	500,000	100.00	500,000
Hickory,	8,367,596	46.87	9,485,659	53.13	17,853,255
Holly, American,	....	....	61,000	100.00	61,000
Hornbeam,	397,184	72.59	150,000	27.41	547,184
Laurel, mountain,	1,000	100.00	....	....	1,000

Table 2.—Summary of State-grown and shipped-in wood used in Pennsylvania, year ending June, 1912—Continued.

Kind of Wood.	Grown in Pennsylvania.		Grown Out of Pennsylvania.		
	Quantity Feet b. m.	Per cent.	Quantity Feet b. m.	Per cent.	Total.
Lignum-vitae,	....	....	2,050	100.00	2,050
Locust, black,	505,850	100.00	....	....	505,850
Mahogany,	....	....	3,680,254	100.00	3,680,254
Maple, red and silver,	3,073,275	53.81	2,638,000	46.19	5,711,275
Maple, sugar,	35,482,200	64.56	19,473,605	35.44	54,955,805
Oak, red,	25,681,362	30.63	58,156,208	69.37	83,837,570
Oak, white,	41,536,349	42.30	56,653,711	57.70	98,190,060
Olivewood,	....	....	480	100.00	480
Persimmon,	....	....	113,010	100.00	113,010
Pine, loblolly,	....	....	51,241,544	100.00	51,241,544
Pine, longleaf,	....	....	108,577,308	100.00	108,577,308
Pine, Norway,	25,000	....	2,302,340	....	2,327,340
Pine, pitch,	4,432,200	41.69	6,198,500	58.31	10,630,700
Pine, scrub,	105,500	4.42	2,280,595	95.58	2,386,095
Pine, shortleaf,	10,000	.01	149,734,213	99.99	149,744,213
Pine, sugar,	....	....	1,213,700	100.00	1,213,700
Pine, western white,	....	....	3,070,500	100.00	3,070,500
Pine, western yellow,	....	....	830,000	100.00	830,000
Pine, white,	69,236,764	43.07	91,512,995	56.93	160,749,759
Red gum,	5,500	.02	22,859,644	99.98	22,865,144
Redwood,	....	....	505,682	100.00	505,682
Rosewood,	....	....	6,185	100.00	6,185
Sassafras,	50	100.00	....	....	50
Satinwood,	....	....	120	100.00	120
Sarbo,	....	....	30	100.00	30
Spanish cedar,	....	....	5,812,660	100.00	5,812,660
Spruce,	1,786,400	8.70	18,752,628	91.30	20,539,028
Spruce, Sitka,	....	....	15,000	100.00	15,000
Sumach,	500	100.00	....	....	500
Sycamore,	31,603	4.53	665,470	95.47	697,073
Tamarack,	300	.74	40,000	99.26	40,300
Teak,	....	....	65,590	100.00	65,590
Walnut, black,	443,705	56.70	338,910	43.30	782,615
Walnut, Circassian,	....	....	108,140	100.00	108,140
Weichsel roots,	....	....	30	100.00	30
Willow, black,	25,000	100.00	....	....	25,000
Yellow poplar,	13,013,636	22.94	43,707,355	77.06	56,720,991
Total,	313,683,632	28.15	800,536,018	71.85	1,114,219,650

SPECIFIC DESCRIPTIONS.

Notwithstanding the very general substitution of other materials like concrete, metals, stone, and clay for wood there is no clear indication that the call for lumber and other forest products is decreasing at this time. With the opening of the Panama Canal and the changing conditions which are constantly taking place in trade, it is difficult to predict what the future will bring forth. As it is there is a large demand for lumber of all kinds and especially for the better grades of native woods. If there were an inexhaustible supply of timber now as there appeared to be fifty years or more ago, there would be less reason for making a study of this kind; but on account of the growing shortage of commercial timber it is most important that investigations be made to determine the qualities of woods that best fit them for a particular use. With this in view, this section of the report has been devoted to a brief account of the several woods used by the manufacturers.

In dealing with the properties of woods in the following paragraphs, a graded set of terms, such as hard, very hard, fairly hard, soft, very soft, etc., is used. These terms of course indicate an approximate scale and apply only to the average run of woods, as many conditions governing the growth of the tree affect materially the structure of the wood so that the same kind appears to have slightly different qualities. Generally the scale of terms used will serve to give a fairly clear idea of the properties of woods. To prevent confusion in their application, efforts have been made not to use them too loosely. The schedule setting forth the terms showing the relative gradations to which all descriptions of qualities conform will be found on page 60. By reference to this schedule the properties of the woods described may readily be studied and compared.

Lumbermen divide woods into two general classes, hardwoods and softwoods. This classification is not based so much upon the qualities of hardness and softness as upon distinction which custom has standardized because it is practical and holds true generally. Hardwoods are trees with broad leaves, while the softwoods have the needle leaf.

THE SOFTWOODS.

There are nineteen species of conifers going into final manufacture in Pennsylvania. Ten of them are pines, constituting nearly fifty per cent. of the total consumption, and of these the supply of seven is obtained entirely from other states, and of the three home-grown species, scrub and pitch pine are required in relatively small amounts, leaving white pine the foremost softwood representative of the Pennsylvania forests. Pine lumber is generally admitted to be the most valuable wood that the earth produces and the species that are used in Pennsylvania together with the other softwoods are described in the order of quantity as follows:

PINES.

White Pine (Pinus Strobus).

White pine was the first lumber tree in Pennsylvania that attracted the attention of the lumbermen. It was not found in this State in thick stands of vast areas like the white pine in the Lake regions and parts of New England, but it grew plentifully in various parts of the State. The trees were generally of large development, and in the early years of lumbering, Pennsylvania trees contributed a large proportion of the total white pine cut of the country. In 1880 the estimated cut of white pine in Pennsylvania amounted to 380,000,000 feet, in 1900, 221,000,000 feet, and in 1910 only 92,000,000 feet. In a few localities the remnants of the original stands are still being cut and here and there trees are found scattered among the hemlocks and hardwoods, besides the second growth that helps to make up the supply. White pine reproduces vigorously and in certain parts of the State under favorable conditions grows with astonishing rapidity. In quantity, it is the most used of any wood for manufacture in Pennsylvania, and owing to its valuable qualities of being light, soft, comparatively durable, of whitish color, easily worked, and holding its shape when in place, it is called for by the factories comprising thirty-two of the fifty-four industries. The largest quantity was used for making planing mill products and general mill work, and the next largest for boxes, these two industries accounting for 71% of the supply going to the Pennsylvania factories. It is interesting to note that white pine cut for Pennsylvania was only 2,000,000 feet more than the reported quantity of home-grown wood used. This gives white pine the distinction of being consumed by manufacturers in the largest proportion of the amount cut in the State of any home grown tree that is important in the production of lumber.

Table 3.—Consumption of White Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products,	62,556,492	38.92	$36 53	$2,285,337	29,261,299	33,295,193
Boxes and crates, packing,	51,583,373	32.09	21 03	1,084,714	19,390,373	32,193,000
Car construction,	12,829,420	7.98	31 38	402,637	4,041,869	8,787,551
Patterns and flasks,	9,141,449	5.69	56 09	512,735	2,276,198	6,865,251
Caskets and coffins,	4,793,000	2.98	18 90	138,495	703,500	4,089,500
Ship and boat building,	4,544,650	2.83	46 85	212,928	2,733,150	1,811,500
Pumps,	2,092,000	1.30	24 59	51,435	1,575,000	517,000
Boards,	1,000,000	.62	32 00	32,000	....	1,000,000
Tanks and silos,	820,000	.51	34.84	28,570	60,000	760,000
Machinery and apparatus, electrical,	787,200	.49	40 02	31,504	150,000	637,200
Toys,	725,000	.45	24 90	18,050	487,500	237,500
Fixtures,	452,450	.28	45 64	20,649	100,450	352,000
Trunks and valises,	428,500	.27	28 60	12,255	128,500	300,000
Furniture,	298,700	.19	44 32	13,239	281,500	17,200
Mine equipment,	239,000	.15	23 70	5,665	13,000	226,000
Baskets, fruit and vegetables,	230,000	.14	21 00	4,830	230,000	....
Woodenware and novelties,	225,000	.14	11 78	2,650	225,000	....
Butchers' blocks and skewers,	200,000	.12	22 00	4,400	200,000	....
Machine construction,	143,500	.09	41 34	5,932	83,500	60,000
Vehicles and vehicle parts,	140,550	.09	34 62	4,866	118,050	22,500
Agricultural implements,	116,000	.07	31 71	3,678	26,000	90,000
Instruments, musical,	88,000	.05	34 56	3,041	....	88,000
Dairymen's, poulterers' and apiarists' supplies,	79,000	.05	22 58	1,784	15,000	64,000
Laundry appliances,	78,200	.05	35 92	2,809	25,000	53,200
Excelsior,	63,500	.04	15 00	953	63,500	....
Elevators,	62,200	.04	40 45	2,516	32,200	30,000
Manual training practice (sloyd),	21,575	.01	72 35	1,561	8,675	12,900
Gates and fencing,	5,000	*	22 00	110	5,000	....
Plumbers' woodwork,	2,500	*	36 00	90	....	2,500
Instruments, professional and scientific,	1,000	*	90 00	90	....	1,000
Refrigerators and kitchen cabinets,	500	*	28 00	14	500	....
Miscellaneous,	7,002,000	4.36	26 00	182,070	7,002,000	....
Total,	160,749,759	100.00	$31 55	$5,071,607	69,236,764	91,512,995

*Less than 1-100 of 1 per cent.

Shortleaf Pine (Pinus echinata).

In quantity shortleaf pine is the most important yellow pine used by the Pennsylvania wood users. It was demanded, next to white pine, in the largest amount of any wood going into final manufacture in the State. Twenty-four industries report using this wood, but over ninety-one per cent. of the total went to three of them: boxes, planing mill products, and car construction. Shortleaf pine grows in Pennsylvania and, to a limited extent, is sawed into lumber; but the manufacturers report the use of the home cut wood in very small quantities and purchase almost their entire supply in the southern states. Shortleaf pine is a soft, yellow wood with considerable sap and has wider rings than the longleaf pine. Its qualities may be indicated as intermediate or coarse grained, moderately hard, dense, tough and elastic, strong, stiff, durable, resinous, moderately stable, rather easy to work, and takes paint well. It is not infrequently bought and sold as longleaf pine, especially that coming from the Gulf states. The Virginia and Carolina shortleaf pine is generally handled under the name North Carolina pine, being a mixture of loblolly and shortleaf in the proportion of about four to one.

Table 4.—Consumption of Shortleaf Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing,	52,719,727	35.21	$18 00	$949,003	....	52,719,727
Planing mill products,	51,870,590	34.64	26 68	1,383,733	....	51,870,590
Car construction,	32,724,334	21.85	26 10	854,105	....	32,724,334
Boards, cloth, hosiery, etc.,	8,000,000	5.34	25 00	200,000	....	8,000,000
Machinery and electrical apparatus,	968,200	.65	21 89	21,191	....	968,200
Mine equipment,	567,000	.38	21 14	11,983	....	567,000
Ship and boat building,	480,800	.32	28 74	13,820	....	480,800
Vehicles and vehicle parts,	467,200	.31	26.67	12,461	....	467,200
Refrigerators and kitchen cabinets,	453,750	.30	27 07	12,284	....	453,750
Fixtures,	256,000	.17	25 92	6,635	....	256,000
Patterns and flasks,	242,012	.16	20 89	5,056	....	242,012
Equipment, playground,	240,000	.16	27 00	6,480	....	240,000
Machine construction,	163,000	.11	23 99	3,910	10,000	153,000
Dairymen's, poulterers', etc.,	145,000	.10	15 69	2,275	....	145,000
Furniture,	141,000	.10	23 92	3,374	....	141,000
Agricultural implements,	95,000	.06	29 74	2,825	....	95,000
Tanks and silos,	86,200	.06	29 47	2,540	....	86,200
Elevators,	50,000	.03	22 00	1,100	....	50,000
Ladders,	25,000	.02	25 00	625	....	25,000
Instruments, musical,	19,900	.01	34 52	687	....	19,900
Plumbers' woodwork,	12,250	.01	28 00	343	....	12,250
Handles,	12,000	.01	30 00	360	....	12,000
Frames and moulding, picture,	5,000	*	30 00	150	....	5,000
Manual training practice (sloyd),	250	*	40 00	10	....	250
Total,	149,744,213	100.00	$23 34	$3,494,950	10,000	149,734,213

*Less than 1-100 of 1 per cent.

Longleaf Pine (Pinus palustris).

For strength, stiffness, and durability, longleaf pine is considered superior to other species of yellow pine. The distinguishing features of the wood are its narrow rings and its relatively small proportion of sapwood. It is hard, with fine straight grain, dense, moderately heavy, elastic, tough; splits rather easily, is fairly hard to work, and does not take paint well. Nearly three-fourths of all that is used in the State is consumed in car building, although seventeen other industries reported its use in varying small amounts. The most prominent among these are planing mill products, ship building, and the manufacture of tanks and silos.

Table 5.—Consumption of Longleaf Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Car construction,	76,932,160	70.85	$32 21	$2,477,985	....	76,932,160
Planing mill products,	19,612,698	18.06	29 39	576,370	....	19,612,698
Ship and boat building,	5,286,000	4.87	37 56	198,520	....	5,286,000
Tanks and silos,	2,565,000	2.36	26 57	68,150	....	2,565,000
Machine construction,	1,431,000	1.32	27 66	39,585	....	1,431,000
Vehicles and vehicle parts,	576,550	.53	34 33	19,791	....	576,550
Agricultural implements,	563,200	.52	31 77	17,893	....	563,200
Mine equipment,	423,000	.39	26 39	11,163	....	423,000
Elevators,	269,900	.25	36 73	9,913	....	269,900
Boxes and crates, packing,	241,800	.22	22 04	5,330	....	241,800
Patterns and flasks,	234,000	.22	20 70	4,844	....	234,000
Weighing apparatus,	200,000	.18	30 00	6,000	....	200,000
Furniture,	138,500	.13	31 83	4,408	....	138,500
Ladders,	50,000	.05	28 00	1,400	....	50,000
Fixtures,	39,500	.04	32 41	1,280	....	39,500
Equipment, playground,	7,000	.01	52 00	364	....	7,000
Caskets and coffins,	6,000	*	37 50	225	....	6,000
Machinery and electrical apparatus,	1,000	*	25 00	25	....	1,000
Total,	108,577,308	100.00	$31 71	$3,443,246	....	108,577,308

*Less than 1-100 of 1 per cent.

Loblolly Pine (Pinus taeda).

Loblolly pine does not grow in Pennsylvania though it has a wide range extending from southern Maryland through all the southern states and extends as far west as Texas. Most of that used in Pennsylvania was reported as coming from Virginia and North Carolina, in which states it constitutes the largest proportion of the lumber production. It is a soft, wide ringed, thick sapped, yellow pine. It has very coarse straight grain, is moderately hard, strong and durable, resinous, brittle, easy to season and work, and takes paint well. It closely resembles shortleaf pine and meets similar uses, so that no attempt is ever made to distinguish it commercially. Over 51,000,000 feet is demanded yearly by the Pennsylvania wood users for a great variety of purposes, but over nine-tenths is reported by the box makers and the manufacturers of sash, doors, blinds, and other planing mill products.

Table 6.—Consumption of Loblolly Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing,	36,173,429	70.59	$17 51	$623,493	....	36,173,429
Planing mill products,	7,307,090	14.26	27 52	201,076	....	7,307,090
Car construction,	4,827,625	9.42	25 98	125,422	....	4,827,625
Boards, cloth, hosiery, etc.,	1,000,000	1.95	18 13	18.125	....	1,000,000
Patterns and flasks,	579,000	1.13	20 27	11,738	....	579,000
Equipment, playground,	400,000	.78	20 00	8,000	....	400,000
Ladders,	400,000	.78	20 00	8.000	....	400,000
Trunks and valises,	160,000	.31	24 22	3,875	....	160,000
Fixtures,	153,000	.30	22 17	3,392	....	153,000
Elevators,	96,500	.20	32 31	3,118	....	96,500
Furniture,	58,000	.11	22 79	1,322	....	58,000
Vehicles and vehicle parts,	41,900	.08	28 07	1,176	....	41,900
Machine construction,	25,000	.05	32 00	800	....	25,000
Instruments, musical,	3,000	.01	40 00	120	....	3,000
Miscellaneous,	17,000	.03	30 00	510	....	17,000
Total,	51,241,544	100.00	$19 91	$1,020,167	....	51,241,544

Pitch Pine (Pinus rigida).

Pitch pine furnishes the largest amount of yellow pine lumber that is cut in Pennsylvania. The tree has a large proportion of sapwood and is decidedly resinous. It grows scatteringly throughout the State and is more extensively used than the total in Table 7 would indicate, owing to the fact that after it is cut into lumber it is difficult for the manufacturer to identify it. The wood is very brittle, of medium weight, hard, coarse grained, weak, stiff, durable, and does not hold paint. Its principal use in Pennsylvania for manufacturing is for boxes and crates, though it meets a wider demand for structural work and for other uses where rough timber is required without further manufacture.

Table 7.—Consumption of Pitch Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates,	6,931,800	65.21	$16 32	$112,519	979,600	5,952,200
Planing mill products,	2,826,000	26.58	22 37	63,206	2,826,000	....
Car construction,	458,600	4.31	16 10	7,383	214,800	243,800
Mine equipment,	246,000	2.32	23 07	5,675	246,000	....
Vehicles and vehicle parts,	55,200	.52	22 77	1,257	55,200	....
Machine construction,	49,100	.46	16 44	807	49,100	....
Patterns and flasks,	44,000	.41	20 84	917	41,500	2,500
Fixtures,	20,000	.19	16 00	320	20,000	....
Total,	10,630,700	100.00	$18 07	$192,084	4,432,200	6,198,500

Western White Pine (Pinus monticola).

This is not the species which produces the white pine lumber of Pennsylvania and the Lake states, but in appearance the wood closely resembles eastern white pine and is suitable for most of the purposes for which the eastern wood is used. Idaho, western Montana, and Washington supplied the most of it used in Pennsylvania. The industries demanding it are the makers of planing mill products and the car builders.

Table 8.—Consumption of Western White Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products,	2,914,500	94.92	$39 55	$115,281	....	2,914,500
Car construction,	87,500	2.85	54 99	4,812	....	87,500
Patterns and flasks,	28,000	.91	56 93	1,594	....	28,000
Fixtures,	20,500	.67	46 78	959	....	20,500
Caskets and coffins,	20,000	.65	42 50	850	....	20,000
Total,	3,070,500	100.00	$40 22	$123,496	....	3,070,500

Scrub Pine (Pinus virginiana).

This tree occurs most frequently in the coastal plain region from New York to Virginia, and for that reason is found in New Jersey and Delaware more extensively than in Pennsylvania. Its range extends from the clay ridges in the southeastern part of the State westward and northward into the foothills and mountain regions, scattered among the hardwoods. The common names in different localities are: Jersey pine, nigger pine, and bastard pine. On cut over areas restocking is heavy and springs up rapidly but the reproduction is best on old fields where in some localities it forms thick stands. It grows more slowly than loblolly or shortleaf and only a comparatively small proportion of the trees reach a size large enough for lumber. It has coarse, straight grain, wide sapwood, and is very brittle, soft, moderately strong, stiff, splits rather easily, is fairly durable and resinous. It can be recognized readily by its short dark green needles, two in a sheath, and by the fact that cones generally remain on the trees several years after they have dropped their seed. In Virginia the box makers and excelsior manufacturers use large quantities of this wood, while in Maryland and Delaware, it is cut into railroad ties, converted into boxes and crates, and, to a limited extent, is used for building materials. In Pennsylvania a quantity equal to the entire cut of yellow pine went to the box makers.

Table 9.—Consumption of Scrub Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing, ...	2,251,400	94.36	$18 93	$42,613	30,000	2,221,400
Planing mill products, ...	70,000	2.93	20 50	1,435	25,000	45,000
Car construction, ...	64,695	2.71	23 32	1,509	50,500	14,195
Total, ...	2,386,095	100.00	$19 10	$45,557	105,500	2,280,595

Norway Pine or Red Pine (Pinus resinosa).

Pennsylvania is the southern limit of the range of Norway or red pine. It occurs in the State infrequently on higher elevations, scattered with hardwoods. The reddish color of the bark is the easiest means of identification. It is most commonly cut into lumber in the New England states and in the Lake states near the Canadian border. All that has been said of white pine generally applies to Norway pine. The two trees grow mixed together and are marketed in most cases indiscriminately as white pine, the other constituting only a relatively small per cent. of the consignment. It differs from white pine in that it is slightly heavier, harder, and more resinous. Where color is a consideration, red pine is separately specified and this accounts for the distinction that the manufacturers make who reported it separately for this investigation. When sold alone as Norway pine it grades lower than white pine. None of that used in Pennsylvania was reported as growing within the State. It has fine, straight grain, medium sapwood, is moderately hard, fairly dense, of medium weight, moderately strong, stiff, non-elastic, fairly brittle, readily split and easily seasoned, easy to work and keeps its shape.

Table 10.—Consumption of Norway Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Car construction, ...	1,518,300	65.24	$28 97	$43,985	25,000	1,493,300
Planing mill products, ...	526,000	22.60	29 20	15,357	....	526,000
Elevators, ...	100,000	4.29	28 00	2,800	....	100,000
Boxes and crates, packing, ...	90,000	3.87	20 00	1,800	....	90,000
Tanks and silos, ...	50,000	2.15	35 00	1,750	....	50,000
Patterns and flasks, ...	43,040	1.85	28 00	1,205	....	43,040
Total, ...	2,327,340	100.00	$28 74	$66,897	25,000	2,302,340

Sugar Pine (Pinus lambertiana).

Sugar pine is the largest pine tree in the United States and is cut almost entirely in California. The name is due to a sugary substance which exudes from the tree when the wood is bruised. It is a true white pine and the wood, except for its being slightly more resinous, is quite similar in appearance to eastern white pine. The uses of the two pines are almost identical, and for a number of purposes the western wood is substituted for the eastern. Sugar pine has a fine straight grain, narrow sapwood, is soft, fairly dense, of very light weight, moderately strong, stiff, non-elastic, easily split and seasoned, and very easy to work. Over a million feet are annually demanded by the Pennsylvania manufacturers. The largest quantity goes to the producers of sash, doors, and blinds. It is also demanded in considerable quantities for foundry patterns and for special uses in store and office fixtures.

Table 11.—Consumption of Sugar Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill prducts, ...	1,122,000	92.45	$48 20	$54,078	....	1,122,000
Patterns and flasks, ...	50,000	4.12	85 00	4,250	....	50,000
Fixtures, ...	25,000	2.06	65 00	1,625	....	25,000
Instruments, musical, ...	11,200	.92	87 50	980	....	11,200
Instruments, professional and scientific, ...	5,000	.41	70 00	530	....	5,000
Manual training practice (sloyd),	500	.04	80 00	40	....	500
Total, ...	1,213,700	100.00	$50 53	$61,323	....	1,213,700

Western Yellow Pine (Pinus ponderosa).

This species next to Douglas fir is more extensively cut into lumber than any of the other western woods, and in the western and central states is used for every purpose for which wood can be employed. Its range includes nearly all of the Rocky Mountain and Pacific coast states. On the market it goes to a large extent as white pine. Sometimes it is called California white pine and in the eastern states dealers give it assumed names, as in Philadelphia it was found being sold as maraschino white pine. The wood in a large number of cases closely resembles white pine and by ocular examination it is difficult to distinguish. It is, however, a true yellow pine, fine grained, and although somewhat heavier and more resinous than white pine, meets a number of uses for which white pine has heretofore been used. It is a cheaper wood and for that reason is a valuable lumber tree and has great possibilities. Box makers and the planing mills are the industries using it most extensively in Pennsylvania.

Table 12.—Consumption of Western Yellow Pine, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing, ...	500,000	60.24	$20 00	$10,000	....	500,000
Planing mill products, ...	320,000	38.56	34 94	11,180	....	320,000
Furniture, ...	10,000	1.20	45 00	450	....	10,000
Total, ...	830,000	100.00	$26 06	$21,630	....	830,000

HEMLOCKS.

Hemlock (Tsuga canadensis).

Although the cut in Pennsylvania is over 150 times the amount the manufacturers use, it is interesting to note than twenty-seven per cent. of the hemlock going into further manufacture came from other states. In 1912 Pennsylvania ranked third in the production of hemlock lumber, being surpassed by Michigan and Wisconsin. Of the imported wood, West Virginia and New York furnished the largest amount. This is the eastern species of the hemlock, that grows from Nova Scotia to Georgia and as far west as Minnesota. It is light, brittle, cross grained, and coarse. It is more difficult to work than the pines and has more of a tendency to warp and twist. It is, however, strong and stiff and non-resinous, holds nails well, and is fairly durable. It is cheaper than similar grades of the principal pines, and in the east central states it is more largely used than any other wood for framing, sheathing, and other uses of rough lumber in building construction. Among the factories of the State, the box industry and that of the planing mills use the largest amounts of this wood, but ten other industries demand small quantities for a variety of purposes.

Western Hemlock (Tsuga heterophylla).

Another species of hemlock was found being used in Pennsylvania, and it is interesting to note that it is the kind that grows only in the far western states commonly known as western hemlock to distinguish it from the eastern wood. This tree usually attains larger sizes than the eastern hemlock, but, like the latter, is found in association with other species and seldom in pure stands. It ranges from two to five feet in diameter and when cut into lumber, generally classes higher, showing less defects than its eastern relative. It is used by only one industry in Pennsylvania, the makers of tanks and silos.

Table 13.—Consumption of Hemlock, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products,	23,077,000	53.63	$21 24	$490,263	15,349,900	7,727,100
Boxes and crates, packing,	9,269,635	21.54	16 85	156,224	5,365,055	3,904,580
Ship and boat building,	4,343,000	10.09	25 92	112,551	4,217,000	126,000
Mine equipment,	2,260,750	5.26	20 82	47,066	2,260,750	....
Car construction,	2,006,075	4.66	15 53	31,153	1,975,075	31,000
Caskets and coffins,	1,000,000	2.32	28 00	28,000	1,000,000	....
Machine construction,	296,000	.69	18 22	5,392	296,000	....
Patterns and flasks,	291,500	.68	18 37	5,356	291,500	....
Dairymen's, poulterers' and apiarists' supplies,	215,000	.50	15 49	3,330	215,000	....
Machinery and apparatus, electrical,	143,600	.33	26 85	3,856	143,600	....
Fixtures,	44,300	.10	26 64	1,180	30,300	14,000
Refrigerators and kitchen cabinets,	37,100	.09	22 13	821	33,100	4,000
Tanks and silos,	25,000	.06	18 00	450	25,000	....
Elevators,	3,800	.01	30 00	114	3,800	....
Instruments, musical,	2,600	.01	35 00	91	1,600	1,000
Manual training practice (sloyd),	262	....	34 35	9	262	....
Miscellaneous,	12,250	.03	28 16	345	10,000	2,250
Total,	43,027,872	100.00	$20 60	$886,201	31,217,942	11,809,930

CYPRESS.

(Taxodium distichum)

In Pennsylvania cypress next to yellow pine is the most widely used of any lumber coming from the southern states. It is typically a swamp tree of the southeastern coast and gulf region and up the Mississippi Basin as far as Missouri. The wood is light, soft, straight-grained, and of fine texture. Though more difficult than some woods to season properly, it holds its shape when thoroughly dried and is one of the most durable woods for which the manufacturers call. These qualities make it desirable for many purposes. The planing mills use the largest quantities, not only for porch, cornice, and other exterior work, but also for doors, sash, panels, moulding and other interior finish. The other seventeen industries in the State demanding this wood and the quantities used are listed in the following table:

Table 14.—Consumption of Cypress (Bald), year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products,	18,790,200	81.01	$39 68	$745,612	....	18,790,200
Boxes and crates, packing,	1,719,250	7.41	16 62	28,570	....	1,719,250
Tanks and silos,	1,138,000	4.90	56 32	64,090	....	1,138,000
Dairymen's, poulterers', etc.,	545,000	2.35	37 02	20,175	....	545,000
Car construction,	352,800	1.52	37 93	13,380	....	352,800
Ship and boat building,	287,000	1.24	55 64	15,970	....	287,000
Fixtures,	111,800	.48	37 38	4,179	....	111,800
Furniture,	80,500	.35	43 19	3,477	....	80,500
Ladders,	62,500	.27	54 64	3,415	....	62,500
Laundry appliances,	39,000	.17	39 10	1,525	....	39,000
Agricultural implements,	30,000	.13	35 00	1,050	....	30,000
Caskets and coffins,	20,000	.09	40 00	800	....	20,000
Elevators,	10,000	.04	55 00	550	....	10,000
Gates and fencing,	3,840	.02	55 00	211	....	3,840
Instruments, musical,	2,500	.01	43 60	109	....	2,500
Manual training practice (sloyd),	1,750	.01	63 43	111	....	1,750
Vehicles and vehicle parts,	1,000	....	50 00	50	....	1,000
Machine construction,	150	....	75 00	11	....	150
Total,	23,195,290	100.00	$38 94	$903,285	....	23,195,290

SPRUCE.

Two species of eastern spruce, namely, red and white, and one northwestern species, Sitka spruce, are reported by the Pennsylvania manufacturers. It is impossible from the information obtained to present separate statistics for the eastern species. The red spruce, the species common in New York, Maine, and New Hampshire, is the tree appearing on the mountains in various parts of Pennsylvania. In 1912 spruce was reported cut by 129 sawmills of the State. The white spruce came into the State largely by water through the Great Lakes, from Wisconsin, Michigan, and Minnesota, where it is the common lumber tree. In appearance, qualities and sizes white spruce resembles red spruce. Spruce lumber irrespective of species is being substituted for white pine, especially in constructive work, box making, tanks and silo manufacture, and many other less important places where white pine was formerly used. Compared with it, however, spruce is weaker, less durable, more brittle, harder to work, whiter and of finer grain. It is nonresinous and therefore valuable for containers of foodstuffs. The western wood, Sitka spruce, comes from Washington and is used for a few special purposes. The planing mills reported its entire amount.

Table 15.—Consumption of Spruce, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing, ...	14,648,870	71.32	$17 42	$255,211	975,350	13,673,520
Planing mill products, ...	1,999,734	9.74	29 96	59,904	176,350	1,823,384
Car construction, ...	1,367,636	6.66	26 35	36,032	189,700	1,177,936
Ship and boat building, ...	1,013,000	4.93	31 06	31,464	200,000	813,000
Refrigerators and kitchen cabinets, ...	413,800	2.01	37 39	15,474	190,000	223,800
Instruments, musical, ...	325,500	1.58	43 24	14,075	....	325,500
Patterns and flasks, ...	223,988	1.09	33 63	7,533	44,000	179,988
Ladders, ...	191,000	.93	43 40	8,290	....	191,000
Frames and moulding, picture,..	100,000	.49	30 00	3,000	....	100,000
Tanks and silos, ...	100,000	.49	20 00	3,000	....	100,000
Machinery and apparatus, electrical, ...	87,700	.43	26 00	2,280	....	87,700
Gates and fencing, ...	36,000	.17	25 00	900	....	36,000
Elevators, ...	10,000	.05	30 00	300	10,000	....
Vehicles and vehicle parts, ...	8,000	.04	48 88	391	1,000	7,000
Fixtures, ...	1,500	.01	42 00	63	....	1,500
Toys, ...	1,300	.01	43 00	56	....	1,300
Woodenware and novelties, ...	1,000	....	43 00	43	....	1,000
Miscellaneous, ...	10,000	.05	20 00	200	....	10,000
Total, ...	20,539,028	100.00	$21 34	$438,216	1,786,400	18,752,628

DOUGLAS FIR.

(Pseudotsuga taxifolia).

Over three and a third million feet of Douglas fir, often called Oregon pine, is brought from the far western states to Pennsylvania to meet the demands of three industries: Ship building, planing mill products, and the manufacture of tanks and silos. It is primarily reported for structural work, because it possesses superior tensile strength, and, because it grows in large sizes and timbers of large dimensions are readily obtainable. In this latter respect it is the chief competitor of longleaf pine in the eastern and middle states. It is also valuable as a decorative wood, owing to its attractive grain and figure and the fact that it takes stain readily. This accounts for its rapid growth in popularity in recent years for doors, moulding, wainscoting, stairwork, and for other interior finish.

Table 16.—Consumption of Douglas Fir, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Ship and boat building, ...	2,521,000	74.94	$42 41	$106,926	....	2,521,000
Tanks and silos, ...	450,000	13.37	43 33	19,500	....	450,000
Machine construction, ...	200,000	5.94	51 25	10,250	....	200,000
Planing mill products, ...	108,500	3.23	43 33	4,701	....	108,500
Car construction, ...	70,238	2.09	45 55	3,199	....	70,238
Miscellaneous, ...	14,400	.43	50 00	720	....	14,400
Total, ...	3,364,138	100.00	$43 19	$145,296	....	3,364,138

CEDARS.

Red Cedar (Juniperus virginiana).

The Pennsylvania wood users report the use of three woods known as cedars. Two of them grow in Pennsylvania and the other is a western wood. Red cedar, often called juniper, has a range covering all the states east and several west of the Mississippi River, but now commercially most abundant in Tennessee and southward. The Pennsylvania factories consume annually 861,000 feet of this and only about two per cent. was cut in the State. It was called for by nine industries, the most important of which were makers of professional instruments, including the lead pencil makers, planing mill products, furniture and caskets.

Table 17.—Consumption of Red Cedar, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Instruments, professional and scientific, ...	240,000	27.32	$52 00	$12,480	....	240,000
Planing mill products, ...	213,000	24.25	49 27	10,495	10,000	203,000
Furniture, ...	178,100	20.27	60 81	10,830	....	178,100
Caskets and coffins, ...	169,000	19.24	66 72	11,275	....	169,000
Dairymen's, poulterers' and apiarists' supplies, ...	45,000	5.12	55 00	2,475	....	45,000
Brushes, ...	23,000	2.62	64 57	1,485	5,000	18,000
Boxes and crates, packing, ...	5,000	.57	35 00	175	2,500	2,500
Manual training practice (sloyd),	400	.04	97 50	39	....	400
Miscellaneous, ...	5,000	.57	40 00	200	....	5,000
Total, ...	878,500	100.00	$56 29	$49,454	17,500	861,000

Western Red Cedar (Thuja plicata).

The western cedar is the largest cedar that grows and it is the foremost shingle wood of the country. It is commonly cut into wide boards and plank and is more abundant than eastern cedar, but the wood is lighter, weaker, softer, less durable, and more spongy in texture. The red cedars are so named on account of the color of the heartwood and the white cedar on account of its lack of color. The planing mills are the only class of factories bringing the western red cedar into Pennsylvania.

Southern White Cedar (Chamaecyparis thyoides).

Southern white cedar grows principally near the Atlantic Coast on lowlands and is best developed in states from New Jersey southward. The western limit of its range is in the extreme eastern portion of Pennsylvania, but none of the wood the manufacturers used was State-grown. The boat builders and the tank and silo makers accounted for ninety-seven per cent. of all the nearly four million feet used in the State. White cedar lumber is readily seasoned, easily worked, splits straight, and is regarded the most durable of any of the domestic woods. It possesses a remarkably straight, fine grain and a fine compact structure. It is probable that a small per cent. of this wood reported as white cedar may have been the northern white cedar often called arborvitae *(Thuja occidentalis)*, but there was nothing in the information received to indicate it. Arborvitae is found on high elevations as far south as North Carolina but south of New York State rarely attains sufficient size to be of any commercial importance.

Table 18.—Consumption of Cedar, Southern White, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Tanks and silos,	2,554,000	68.34	$36 31	$92,740	....	2,554,000
Ship and boat building,	1,081,000	28.92	56 40	60,970	....	1,081,000
Gates and fencing,	100,000	2.68	20 00	2,000	....	100,000
Furniture,	1,300	.03	120 00	156	....	1,300
Planing mill products,	1,000	.03	120 00	120	....	1,000
Total,	3,737,300	100.00	$41 74	$155,986	....	3,737,300

REDWOOD

(Sequoia sempervirens).

This tree is closely related to the famous "Big Trees," which attain the largest size of any known tree. Practically all of the redwood lumber produced in this country comes from California. Redwood, and the sugar pine, the other California wood described above, are the highest priced softwoods that the Pennsylvania manufacturers report. Owing to its fine texture, great durability, stability in place, and excellent quality, redwood is more and more entering the eastern markets in spite of its cost. Its name is due to the red color of its wood, which fades when long exposed to the weather.

Table 19.—Consumption of Redwood, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products,	197,132	38.98	$49 19	$9,697	....	197,132
Patterns and flasks,	136,000	26.89	60 74	8,260	....	136,000
Car construction,	100,000	19.77	36 00	3,600	....	100,000
Caskets and coffins,	20,000	3.96	54 00	1,080	....	20,000
Printing material,	20,000	3.96	63 00	1,260	....	20,000
Ship and boat building	20,000	3.96	52 30	1,046	....	20,000
Instruments, musical,	10,000	1.98	40 00	400	....	10,000
Rollers and poles,	2,000	.39	45 00	90	....	2,000
Fixtures,	500	.10	55 00	28	....	500
Manual training practice (sloyd),	50	.01	60 00	3	....	50
Total,	505,682	100.00	$50 36	$25,464	....	505,682

TAMARACK.

(Larix laricina).

Pennsylvania marks the southern limit of the eastern species of tamarack. Of the limited quantity of lumber used by the factories, a small per cent. was from timbers cut in the extreme northwestern part of the State. It is distinctly a swamp tree, but the wood in its physical properties is similar to southern pine, although it is claimed to be more durable. In quality it is hard, dense, moderately heavy, strong, very stiff, moderately tough, elastic, hard to split, difficult to work, non-resinous, and with an intermittent grain. Only two industries in Pennsylvania reported the use of tamarack. It went for parts in boat building and to the planing mills for finished material used in house construction.

BALSAM FIR.

(Abies balsamea.)

Balsam fir is found growing in Pennsylvania, but being near the southern limit of its range the trees are of small size and of little commercial value. In the Lake states and in New England, as well as throughout the whole of Canada, this tree grows in swamps, usually associated with tamarack, black spruce, white cedar, etc. It appears also on the uplands, but it is much less common. The wood is soft, weak, and perishable, but has long, tough, colorless fibers, which make it valuable in paper manufacture. Like black spruce, its principal use is for pulp.

In Canada ninety-five per cent. of this wood is said to be cut for this purpose. The lumber serves many of the purposes for which spruce is demanded, but in Pennsylvania the planing mills were the only class of manufacturers reporting it.

THE HARDWOODS.

In the use of wood for making articles of final form a larger quantity of softwood is demanded than of hardwood; but the hardwoods meet a greater number of uses than softwoods and are more important as to distribution among the various industries. The hardwoods form about forty-five per cent. of the total lumber cut in the State, and of the thirty-five kinds reported for manufacture, exclusive of the imported foreign woods, all but five were cut wholly or in part within the State, while of the twenty-three conifers or softwoods a portion of the supply of only thirteen were returned as State-grown.

OAKS.

The oaks are the leading hardwoods consumed by the Pennsylvania wood users. In trade the wood of the oaks is separated into two general classes, white oaks and red oaks, but the botanist's classification, which is based on difference in flower, fruit, and leaf, divides the oaks into more than fifty species. The manufacturer bases his distinction upon the qualities of the wood. The white oaks possess an even grain and fine texture, and are usually strong, hard, heavy, tough, dense, and durable but difficult to season; the red oaks are less strong and durable, and not so dense, but more easily worked because softer, more easily kiln-dried and, on account of being more porous they take stains and varnish more readily. Oak is brought into Pennsylvania in greater quantities than any other wood except shortleaf pine notwithstanding the fact that the cut of State-grown oak exceeds the quantity used by the manufacturers by over ninety million feet. There are many instances in which oak is demanded because it is the best suited and often the only practical material for the purpose. This accounts for the wood being first in importance for meeting a greater number of uses in Pennsylvania than any other American wood. Thirty-five industries demand some one or more of the white oak group and thirty-two industries one or more of the red oaks. The number of uses reported, as shown in the summary in the following pages, for the white oak is 738 and for the red oak 310. The car builders consume over one-half of the former and considerably more than one-third of all the latter that goes into further manufacture in the State. The furniture makers, including the chair industry, use over six and one-half million feet more red than white oak, but on the other hand, for vehicles, ship building, machine construction and agricultural implements white oak is largely preferred to red oak. For a comparison of the qualities of the two classes, the white oaks may be said generally to have intermediate straight grain, and are very hard, porous, very heavy, very strong, moderately stiff and elastic, and tough. They also split easily, are durable, rather difficult to season and to work. The red group generally are relatively coarse, straight grained, very hard, very porous, heavy, strong, stiff, non-elastic, and tough. This wood splits rather easily, is moderately durable, and rather difficult to season.

Table 20.—Consumption of Oak, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Car construction,	81,393,363	44.72	$26 14	$2,127,488	30,089,792	51,303,571
Planing mill products,	29,806,771	16.38	44 05	2,313,133	10,809,400	18,997,371
Furniture,	26,224,750	14.41	40 20	1,054,280	5,214,650	21,010,100
Vehicles and vehicle parts,	7,873,867	4.33	35 48	279,372	4,968,100	2,905,767
Boxes and crates, packing,	7,604,877	4.18	16 08	122,249	1,949,877	5,655,000

Table 20—Concluded.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Ship and boat building, ...	6,305,400	3.46	34 92	220,206	3,410,900	2,894,500
Chairs and chair stock, ...	5,226,000	2.87	37 43	195,622	1,348,300	3,877,700
Fixtures, ...	4,228,060	2.32	50 63	214,086	813,100	3,414,960
Agricultural implements, ...	3,295,700	1.81	34 12	112,448	1,334,700	1,961,000
Machine construction, ...	2,923,600	1.61	26 59	77,749	2,558,600	365,000
Mine equipment, ...	2,827,772	1.55	17 22	48,697	2,827,772	....
Caskets and coffins, ...	1,188,500	.65	50 02	59,452	132,500	1,056,000
Equipment, playground, ...	607,300	.33	33 65	20,437	314,800	292,500
Refrigerators and kitchen cabinets, ...	565,900	.31	32 82	18,571	250,000	315,900
Toys, ...	277,300	.15	28 32	7,852	232,800	44,500
Dairymen's, poulterers' and apiarists' supplies, ...	241,000	.13	20 26	4,883	200,000	41,000
Plumbers' woodwork, ...	219,500	.12	41 90	9,197	70,000	149,500
Instruments, musical, ...	190,000	.10	42 28	8,033	33,000	157,000
Baskets and veneer packages for fruit and vegetables, ...	125,000	.07	23 00	2,875	125,000	....
Machinery and apparatus, electrical, ...	123,500	.07	33 08	4,085	10,000	113,500
Frames and moulding, picture,	119,000	.07	54 30	6,462	29,000	90,000
Insulator pins and brackets, ..	115,000	.06	12 61	1,450	115,000	....
Saddles and harness, ...	78,000	.04	68 21	5,320	60,000	18,000
Handles, ...	74,000	.04	25 42	1,881	74,000	....
Laundry appliances, ...	60,000	.03	23 50	1,410	20,000	40,000
Elevators, ...	53,200	.03	48 03	2,555	23,200	30,000
Tanks and silos, ...	50,000	.03	43 00	2,150	50,000	....
Sporting and athletic goods, ...	42,000	.02	38 21	1,605	31,500	10,500
Patterns and flasks, ...	36,000	.02	34 67	1,248	36,000	....
Shuttles, spools and bobbins, ..	35,000	.02	50 00	1,750	5,000	30,000
Woodenware and novelties, ...	27,100	.02	31 88	864	26,600	500
Manual training practice (sloyd), ...	23,570	.01	77 64	1,830	14,020	9,550
Pulleys and conveyors, ...	20,500	.01	28 05	575	20,500	....
Rollers and curtain poles, ...	19,000	.01	16 63	316	19,000	....
Clocks, ...	16,500	.01	68 97	1,138	....	16,500
Instruments, professional and scientific, ...	10,000	.01	55 00	550	....	10,000
Brushes, ...	600	*	37 00	22	600	....
Total, ...	182,027,630	100.00	$32 59	$5,931,841	67,217,711	114,809,919
					36.93% in.	63.07% out.

*Less than 1-100 of one per cent.
†The white and red oak groups have been combined in this table.
In Part II of the Report the information is given separately.

YELLOW POPLAR.

(Liriodendron tulipifera).

Forty-one classes of factories demand yellow poplar, which next to sugar maple, shows the widest distribution among industries of any wood that Pennsylvania factories demand. In this particular it excels white oak. The number of particular uses (see table of uses) reported for yellow poplar, however, is nearly 50 per cent. less than for white oak, while the total poplar used in the State was less by forty million feet. Yellow poplar is of fine texture, more easily worked, takes paint readily, and holds its shape after drying better than any other domestic wood. In texture it is similar to basswood. Because it is frequently called whitewood it is often confused with basswood, but is softer. There is a great difference between the heartwood and the sapwood of yellow poplar; the former in a number of instances being sold on the market as yellow poplar because of its yellow color, and the latter as white poplar or whitewood, and therefore number of instances being sold on the market as yellow poplar because of its yellow color, and the latter as white poplar or whitewood, and therefore often regarded by users as separate species. The tree is frequently called tulip tree and the wood tulip poplar. There is but one species of this genus in this country. It is interesting to note that of the total amount of yellow poplar going into manufacture, over thirteen million feet were cut from State-grown timber. This amount was about two million feet less than the reported cut of this species in the State.

Table 21.—Consumption of Yellow Poplar, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing, ...	18,576,293	32.75	$17 44	$323,871	4,330,100	14,246,193
Planing mill products, ...	17,123,372	30.19	37 38	640,042	4,127,990	12,995,382
Vehicles and vehicle parts, ...	3,764,335	6.64	50 49	190,055	755,285	3,009,050
Car construction, ...	3,172,113	5.59	57 43	182,175	310,611	2,861,502
Furniture, ...	2,892,000	5.10	36 86	106,593	346,700	2,545,300
Fixtures, ...	2,237,000	3.94	37 21	83,229	167,500	2,069,500
Boards, ...	1,070,000	1.89	29 38	31,440	....	1,070,000
Boxes, cigar, ...	1,040,928	1.84	75 31	78,465	24,500	1,017,428
Agricultural implements, ...	757,500	1.33	34 59	26,205	33,000	724,500
Caskets and coffins, ...	748,000	1.32	32 10	24,008	432,000	316,000
Toys, ...	702,000	1.24	25 48	17,888	659,500	42,500
Excelsior, ...	688,000	1.21	15 00	10,030	688,000	....
Machine construction, ...	640,800	1.13	42 86	27,463	29,800	611,000
Laundry appliances, ...	610,000	1.07	16 44	10,030	500,000	110,000
Refrigerators and kitchen cabinets, ...	566,200	1.00	28 27	16,009	363,000	203,200
Woodenware and novelties, ...	482,500	.85	29 11	14,045	27,500	455,000
Shuttles, spools, and bobbins, ...	321,000	.57	36 50	11,715	25,000	296,000
Dairymen's, poulterers' and apiarists' supplies, ...	220,000	.39	29 82	6,560	....	220,000
Brushes, ...	157,500	.28	40 68	6,407	32,500	125,000
Instruments, musical, ...	135,100	.24	70 54	9,530	24,000	111,100
Plumbers' woodwork, ...	134,000	.24	40 00	5,360	....	134,000
Pumps, ...	100,000	.18	45 00	4,500	....	100,000
Frames and moulding, pictures,	87,000	.15	38 51	3,350	....	87,000
Ship and boat building, ...	84,000	.15	58 07	4,878	2,500	81,500
Elevators, ...	82,600	.14	41 88	3,459	30,600	52,000
Pulleys and conveyors, ...	80,000	.14	28 75	2,300	10,000	70,000
Patterns and flasks, ...	46,500	.08	38 82	1,805	37,500	9,000
Clocks, ...	35,000	.06	33 57	1,175	....	35,000
Boot and shoe findings, ...	30,000	.05	56 67	1,700	....	30,000
Equipment, playground, ...	25,000	.04	36 00	900	12,500	12,500
Chairs and chair stocks, ...	24,600	.04	38 05	936	....	24,600
Instruments, professional and scientific, ...	16,400	.03	73 78	1,210	....	16,400
Manual training practical (sloyd), ...	16,250	.03	66 95	1,088	9,550	6,700
Mine equipment, ...	14,000	.02	22 50	315	14,000	....
Machinery and apparatus, electric, ...	10,000	.02	55 60	556	....	10,000
Weighing apparatus, ...	10,000	.02	25 00	250	10,000	....
Gates and fencing, ...	5,000	.01	26 00	130	5,000	....
Printing material, ...	5,000	.01	18 00	90	....	5,000
Sporting and athletic goods, ...	5,000	.01	28 00	140	5,000	....
Ladders, ...	4,000	.01	21 00	84	....	4,000
Rollers and poles, ...	1,000	*	65 00	65	....	1,000
Total, ...	56,720,991	100.00	$32 62	$1,850,151	13,013,636	43,707,355

*Less than 1-100 of 1 per cent.

MAPLES.

Three maples are cut for lumber in Pennsylvania, sugar maple, sometimes called hard maple *(Acer saccharum)*, the red or soft maple *(Acer rubrum)*, and the white or silvery maple (*Acer saccharinum).* Of these the sugar maple is commercially the most important and it is probably the most valuable wood produced in Pennsylvania. This is because of the abundance of maple sugar it produces, the choice figured woods known as bird's eye and curly maple, etc., and the many uses for which this wood alone is the most adaptable, owing to its combined qualities or strength, hardness, stiffness, and its ability to hold its shape after being properly seasoned. Forty-two industries report its use, which is a greater number than for any other wood named in this report. It is abundant on well-drained land, particularly in the northern, western, and middle portions of the State. Next to white oak, sugar maple was reported as meeting the greatest number of uses, and was the fourth important hardwood in the total quantity used. It also bears the distinction, among the woods that are used in quantities exceeding 5,000,000 feet, of furnishing the largest proportion of State-grown wood.

Table 22.—Consumption of Sugar Maple, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing,	11,647,000	21.19	$16 43	$191,340	3,282,500	8,364,500
Planing mill products,	9,681,890	17.62	23 75	229,963	8,673,090	1,008,800
Laundry appliances,	6,340,500	11.54	23 75	150,613	3,385,500	2,955,000
Chairs and chair stock,	5,348,100	9.73	18 54	99,180	4,746,500	601,600
Furniture,	4,743,900	8.63	26 72	126,632	3,640,100	1,103,800
Shuttles, spools, and bobbins,	2,528,000	4.60	24 85	62,816	1,870,000	658,000
Handles,	2,307,850	4.20	19 02	43,897	1,727,700	580,150
Car construction,	1,976,110	3.60	18 14	35,856	1,344,660	631,450
Brushes,	1,066,800	1.94	23 22	24,772	1,066,800	....
Woodenware and novelties,	1,040,500	1.89	23 34	24,280	737,500	303,000
Agricultural implements,	1,032,600	1.88	28 04	28,952	365,500	667,100
Mine equipment,	790,200	1.44	18 67	14,751	790,200	....
Toys,	762,500	1.39	25 31	19,300	712,500	50,000
Boards,	705,000	1.28	46 45	32,750	50,000	655,000
Instruments, musical,	647,800	1.18	32 20	20,857	225,300	422,500
Vehicles and vehicle parts,	625,800	1.14	28 67	17,940	314,200	311,600
Machinery and apparatus, electrical,	558,500	1.02	34 85	19,465	150,000	408,500
Baskets, fruit and vegetable,	549,000	1.00	18 15	9,963	549,000	....
Pumps,	400,000	.72	17 00	6,800	400,000	....
Fixtures,	366,000	.67	23 17	8,482	317,500	48,500
Machine construction,	288,700	.53	29 69	8,572	145,700	143,000
Butchers' blocks and skewers,	270,000	.49	20 37	5,500	270,000	....
Whips, canes, and umbrella sticks,	241,100	.44	17 57	4,237	241,100	....
Weighing apparatus,	171,000	.31	33 13	5,665	21,000	150,000
Dairymen's, poulterers' and apiarists' supplies,	152,950	.28	27 96	4,276	23,500	129,450
Elevators,	141,200	.26	49 74	7,023	81,200	60,000
Boot and shoe findings,	100,500	.18	55 86	5,614	....	100,500
Sporting and athletic goods,	97,500	.17	36 14	3,524	47,500	50,000
Refrigerators and kitchen cabinets,	80,750	.15	28 71	2,318	80,750	....
Pulleys and conveyors,	68,000	.12	43 68	2,970	66,000	2,000

Table 22—Concluded.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Patterns and flasks, ...	50,550	.09	47 46	2,399	38,850	11,700
Ladders, ...	50,000	.09	27 00	1,350	50,000	....
Caskets and coffins, ...	35,000	.06	25 00	875	....	35,000
Rollers and poles, ...	27,425	.05	16 59	455	27,000	425
Equipment, playground, ...	23,000	.04	26 96	620	3,000	20,000
Frames and moulding, picture,	20,000	.04	22 50	450	20,000	....
Ship and boat building, ...	3,500	.01	29 14	102	2,500	1,000
Manual training practice (Sloyd), ...	3,350	.01	50 45	169	3,050	300
Instruments, professional and scientific, ...	930	......	40 00	37	500	430
Printing material, ...	500	......	80 00	40	500	....
Plumbers' woodwork, ...	300	......	30 00	9	....	300
Miscellaneous, ...	11,500	.02	20 00	235	11,500	....
Total, ...	54,955,805	100.00	$22 29	$1,225,049	35,482,200	19,473,605

Red and Silver Maple.

Red and silver maple both go in commerce under the name of soft maple. The former is cut from the hills and mountains of the State, where it grows abundantly and is associated with beech, birch, and hemlock, while the latter thrives best in bottomlands and along streams, in company with the willows, black ash, and river birch. The wood of these soft maples is similar to that of sugar maple except that it is lighter, softer, and slightly tougher. Relatively, they meet only a few uses and are distributed among only nineteen industries. Maple lumber, including all species, ranks next to oak in the hardwood cut of Pennsylvania.

Table 23.—Consumption of Red and Silver Maple, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b m.	Per cent.			Feet b. m.	Feet b. m.
Furniture, ...	1,478,500	25.89	$25 49	$37,682	730,500	748,000
Boxes and crates, packing, ...	1,267,000	22.18	12 38	15,685	872,000	395,000
Chairs and chair stock, ...	918,500	16.08	28 17	25,876	155,000	763,500
Toys, ...	450,000	7.88	24 00	10,800	450,000	....
Shuttles, spools, and bobbins,..	375,000	6.57	26 43	9,910	40,000	335,000
Fixtures, ...	260,000	4.55	15 00	3,900	260,000	....
Woodenware and novelties, ...	210,525	3.68	14 43	3,038	210,525	....
Brushes, ...	156,000	2.73	18 96	2,957	136,000	20,000
Baskets, fruit and vegetable, ..	145,000	2.54	20 00	2,900	....	145,000
Whips, canes, and umbrella sticks, ...	107,000	1.87	26 45	2,830	2,000	105,000

Table 23—Concluded.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Laundry appliances, ...	80,000	1.40	25 00	1,990	42,500	37,500
Planing mill products, ...	71,750	1.26	26 19	1,879	31,750	40,000
Vehicles and vehicle parts, ...	47,000	.82	26 13	1,228	47,000	....
Instruments, musical, ...	44,000	.77	26 82	1,180	....	44,000
Printing material, ...	25,000	.44	31 60	790	20,000	5,000
Dairymen's, poulterers' and apiarists' supplies, ...	15,000	.26	10 00	150	15,000	....
Pulleys and conveyors, ...	10,000	.18	14 00	140	10,000	....
Patterns and flasks, ...	1,000	.02	55 00	55	1,000	....
Miscellaneous, ...	50,000	.88	14 00	700	50,000	....
Total, ...	5,711,275	100.00	$21 66	$123,690	3,073,275	2,638,000

CHESTNUT.

(Castanea dentata).

Over 1,000 sawmills in Pennsylvania report the cut of chestnut, and the production of this lumber exceeds that of any other hardwood cut in the State. Manufacturers, classified among twenty-seven industries, report chestnut for nearly 200 separate and distinct uses. Though Pennsylvania is second in importance in the production of chestnut lumber and annually cuts nearly twice as much as the manufacturers consume, only forty per cent. of the total quantity purchased was home-grown wood. The wood is coarse straight grained, light weight, moderately strong and hard, very stiff and brittle, durable when exposed, easily seasoned, and holds nails well. The wood is also rich in tannin and is therefore largely used in making tannin extracts. Its other valuable qualities are ease in working, great porosity, stiffness. non-elasticity, light weight, and brittleness. It has an attractive grain and a beautiful figure, and therefore has lately grown in popularity for inside finish of houses and buildings. Nearly two-thirds of the reported usage by manufacturers in Pennsylvania is for these and other planing mill products. The largest demand for chestnut is for rough forest products, as posts, telegraph poles, cross ties, mine props and tanning extract. The growing tree is subject to attacks by boring insects, which make the wood usually defective. Large quantities of the chestnut lumber used in Pennsylvania, therefore, are of the low grade known as "sound wormy" which shows the galleries of insect larvae, but is otherwise sound. It is this grade which the box makers use in amounts equal to more than twenty-three per cent. of the total, and it is this grade that the furniture manufacturers and piano builders demand for veneer backing, being light, holding its shape well, and with a special affinity for glue, and is especially adapted for this purpose. The casket makers use chestnut ahead of any other wood as experience has proved that this wood is one of the most durable underground. The sound wormy grade is most frequently employed as the injury by the borers does not seem to affect particularly its lasting qualities.

In recent years, the chestnut bark disease that has killed chestnut trees in New York and southern New England has made great inroads on the stand in Pennsylvania. The rapid spread of the infection and its devastation in the infected areas of the State has produced such an alarming situation that the Commonwealth of Pennsylvania adopted measures looking to the possible control of the disease. A chestnut tree killed by the blight is killed by the girdling of the trunk. The disease does not injure the wood although it penetrates a few annual rings. The problem of utilizing the blight killed wood, the Federal Government has ascertained, is merely a question of using dead timber. The wood generally answers for all purposes for which healthy chestnut is demanded, and recent official strength tests have proved that sound killed chestnut is fully as strong as live healthy wood. To owners of blight killed timber, the Forest Service has pointed out the necessity of its use within two years after death as subsequent to that period, deterioration, due to checking, insect injury and decay, is quite rapid.

Table 24.—Consumption of Chestnut, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products, ...	17,409,350	33.92	$37 65	$655 450	5,815,700	11,593,650
Boxes and crates, ...	11,977,692	23.34	16 04	192,165	6,275,328	5,702,364
Furniture, ...	11,556,850	22.52	19 52	225,599	5,586,300	5,970,550
Caskets and coffins, ...	5,387,000	10.50	20 57	110,807	1,573,500	3,813,500
Fixtures, ...	1,803,350	3.51	25 16	45,364	1,114,250	689,100
Mine equipment, ...	749,405	1.46	15 42	11,557	749,405	....
Instruments, musical, ...	671,900	1.31	24 81	16,669	327,000	344,900
Toys, ...	500,000	.97	21 00	10,500	500,000	....
Chairs and chair stock, ...	480,000	.94	17 71	8,499	95,000	385,000
Agricultural implements, ...	140,000	.27	19 07	2,670	40,000	100,000
Patterns, and flasks, ...	128,200	.25	19 24	2,466	47,500	80,700
Car construction, ...	113,250	.22	21 04	2,383	113,250	....
Baskets, fruit and vegetable, ..	100,000	.19	19 00	1,900	100,000	....
Frames and moulding, picture,	93,000	.18	22 41	2,084	25,000	68,000
Machine construction, ...	73,000	.14	35 67	2,604	23,000	50,000
Trunks and valises, ...	37,500	.07	25 00	938	17,500	20,000
Vehicles and vehicle parts, ...	30,200	.06	19 77	597	18,200	12,000
Tanks and silos, ...	15,000	.03	20 00	300	15,000	....
Refrigerators and kitchen cabinets, ...	11,800	.02	28 05	331	11,800	....
Gates and fencing, ...	11,500	.02	25 39	292	6,500	5,000
Sporting and athletic goods, ..	10,000	.02	33 00	330	5,000	5,000
Manual training practice (sloyd), ...	7,000	.01	64 14	448	5,000	2,000
Excelsior, ...	5,000	.01	14 00	70	5,000	....
Clocks, ...	5,000	.01	30 00	150	5,000	....
Elevators, ...	4,000	.01	70 00	280	....	4,000
Ship and boat building, ...	3,100	.01	27 10	84	3,100	....
Laundry appliances, ...	3,000	.01	24 00	72	2,000	1,000
Total, ...	51,326,097	100.00	$25 22	$1,294,609	22,479,333	28,846,764

43.80% in. 56.20% out.

BEECH.

(Fagus atropunicea)=(F. grandifolia).

Considering that thirty-three industries demand beech for more than 230 distinct uses, it can properly be termed one of Pennsylvania's important hardwoods, though not many years ago it was considered by manufacturers of little value. There is but one species in Pennsylvania and its stand is abundant, especially in the northeastern, northern, and western portions of the State, where are located most of the 800 or more mills that report cutting it. Pennsylvania produces more beech lumber than any other state east of the Ohio river, and in this respect stands third in importance in the United States. It is quite surprising that so large a quantity of low grade beech lumber, such as is used by the box makers, was shipped in, if one considers that the cut of this wood in Pennsylvania exceeds the consumption of home-grown wood by over 22,000,000 feet. The wood of the beech tree is not first class lumber like its associates, the maples and birches. It is usually cross-grained, not durable, difficult to season, and frequently warps and checks when in place, even after it has been thoroughly dried. It is, however, strong, hard, and moderately stiff, and these qualities combined, together with the fact that it is cheap, make it desirable for a great number of uses. It is especially adapted for turning stock and for that reason it is one of the leading woods appearing in the chair industry and in the making of brooms and mop handles. The planing mills use it largely for flooring, but for this purpose it is not in so great demand in this State as in the New England states, where a large quantity of beech shipped from Pennsylvania is used, being preferred to the New England wood owing to its better quality. The brush makers want large quantities of beech for scrubbing and other cheap brush blocks, while the woodenware and toy makers demand it in large quantities for many special uses. It is the most important wood for laundry appliances, especially for clothes pins, for which it is used probably in larger quantities in the country at large than any other wood.

Table 25.—Consumption of Beech, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing, ..	12,505,839	31.08	$16 17	$202,272	3,735,339	8,770,500
Chairs and chair stocks, ...	8,420,000	20.92	17 21	144,945	7,295,000	1,125,000
Woodenware and novelties, ...	3,639,000	9.04	20 46	74,446	3,356,000	283,000
Planing mill products, ...	2,461,750	6.12	16 35	40,250	1,972,250	489,500
Brushes, ...	1,931,000	4.80	18 87	36,430	1,931,000	....
Handles, ...	1,752,300	4.35	17 31	30,412	1,302,800	449,500
Furniture, ...	1,453,000	3.61	16 23	23,584	1,397,000	56,000
Laundry appliances, ...	1,432,000	3.56	15 95	22,842	1,352,000	80,000
Car construction, ...	1,377,500	3.42	17 12	23,583	847,500	530,000
Frames and moulding, picture,	1,200,000	2.98	20 08	24,100	600,000	600,000
Baskets, fruit and vegetable,..	1,079,000	2.68	18 62	20,093	949,000	130,000
Mine equipment, ...	656,525	1.63	17 94	11,781	656,525	....
Toys, ...	627,400	1.56	18 41	11,553	585,000	42,400
Vehicles and vehicle parts,....	587,883	1.46	21 97	12,916	537,883	50,000
Whips, canes, and umbrella sticks, ...	266,500	.66	21 91	5,838	252,000	14,500
Equipment, playground, ...	130,000	.32	29 46	3,830	130,000	....
Excelsior, ...	116,500	.29	15 00	1,748	116,500	....
Dairymen's, poulterers' and apiarists' supplies, ...	100,000	.25	16 00	1,600	100,000	....
Fixtures, ...	71,000	.18	21 85	1,551	60,000	11,000
Refrigerators and kitchen cabinets, ...	55,000	.14	17 36	955	30,000	25,000

Table 25—Concluded.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Pumps,	50,000	.12	15 00	750	50,000	....
Agricultural implements,	42,000	.10	22 86	960	32,000	10,000
Ladders,	22,000	.05	18 27	402	22,000	....
Instruments, musical,	20,000	.05	22 00	440	....	20,000
Sporting and athletic goods,	20,000	.05	17 25	345	20,000	....
Pulleys and conveyors,	15,000	.04	20 00	300	15,000	....
Rollers and poles,	12,000	.03	14 00	168	12,000	....
Machine construction,	11,000	.03	14 55	160	11,000	....
Patterns and flasks,	10,000	.03	25 00	250	10,000	....
Ships and boat building,	2,500	.01	26 00	65	1,500	1,000
Printing material,	2,000	.01	30 00	60	2,000	....
Manual training practice (sloyd),	600	....	28 33	17	600	....
Miscellaneous,	175,003	.43	14 86	2,600	175,003	....
Total,	40,244,300	100.00	$17 42	$701,244	27,556,900	12,687,400

RED GUM.

(Liquidambar styraciflua).

Red gum in late years has grown in commercial importance more than any other domestic wood. It was formerly considered of little value, owing to difficulty in seasoning; but with the coming of improved methods of kiln-drying, both for veneer and lumber, these obstacles have been overcome and the wood has become available for a great number of uses. It was reported in Pennsylvania by twenty-three industries. The red gum tree grows in Pennsylvania, especially in the southeastern and middle portions of the State, where its cut was reported by 130 mills. It is not related, as its common name indicates, to the other gums, the water gum, and black gum, the cotton or tupelo gum, though often growing with them in the southern extension of its range. The red gum has a starlike leaf and bears its numerous seeds in spiny, round balls. The black gum has an oval leaf, and bears a small bluish black drupe containing a single seed. The wood of the red gum is fairly strong, soft and tough. It has a slightly interlocked grain, a fine, uniform texture, and takes a good polish. The color of the wood is not uniform. The sapwood is almost white and on the market is sold separately as sap gum. The heartwood is generally a reddish light brown. In some trees it is uniformly dark, while in others the dark wood runs in irregular streaks mottling the wood and giving it a figure resembling Circassian walnut. Pennsylvania furniture makers use this wood in the largest quantities, finishing it often to imitate more expensive hardwoods, mahogany, walnut, quarter-sawed oak, and cherry.

Table 26.—Consumption of Red Gum, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing,	12,806,084	56.01	16 68	$213,611	....	12,806,084
Chairs and chair stock,	4,326,000	18.92	25 97	112,328	....	4,326,000
Furniture,	2,297,000	10.05	34 25	78,666	....	2,297,000
Planing mill products,	1,610,300	7.04	31 31	50,422	....	1,610,300
Boxes, cigar,	549,750	2.41	49 79	27,373	....	549,750
Vehicles and vehicle parts,	315,500	1.38	32 37	10,212	500	315,000
Woodenware and novelties,	225,000	.98	23 50	5,287	....	225,000
Handles,	195,000	.85	29 38	5,730	....	195,000
Mine equipment,	150,000	.66	12 00	1,800	....	150,000
Fixtures,	94,000	.41	44 00	4,136	....	94,000
Instruments, musical,	50,000	.22	51 20	2,560	....	50,000
Frames and moulding, picture,	50,000	.22	30 00	1,500	....	50,000
Brushes,	37,000	.16	27 00	999	....	37,000
Car construction,	35,140	.15	27 02	950	....	35,140
Caskets and coffins,	30,000	.13	40 00	1,200	....	30,000
Agricultural implements,	24,000	.11	36 00	864	....	24,000
Trunks and valises,	20,000	.09	35 00	700	....	20,000
Whips, canes, and umbrella sticks,	20,000	.09	50 00	1,000	....	20,000
Pipes, tobacco,	12,000	.05	50 00	600	....	12,000
Clocks,	10,000	.04	60 00	600	....	10,000
Toys,	5,000	.02	25 00	125	5,000	....
Refrigerators and kitchen cabinets,	2,900	.01	50 00	145	....	2,900
Manual training practice (sloyd),	470	....	72 34	34	....	370
Total,	22,865,144	100.00	$22 78	$520,842	5,500	22,859,644

BASSWOOD.

(Tilia americana).

Probably a larger per cent. of the cut of basswood in Pennsylvania goes to the manufacturers than that of any other hardwood. Four hundred and thirty mills in 1912 report cutting over 10,000,000 feet, while the wood-using factories consumed almost 8,000,000 feet, making more than 200 distinct commodities. There is one species of basswood of commercial importance growing in Pennsylvania, and it is found in all parts of the State, but more abundantly on rich, well drained soils. It is a favorite shade tree and for that purpose is extensively planted. Lumbermen often refer to the tree as linden and call the lumber "linn," but throughout its range it is probably most commonly known as basswood. This is due to the "bast" or inner bark, which is of considerable commercial importance for making cords, ropes, and doormats. Especially in midsummer is the tree easily identified, when the fragrant yellow flowers attract the attention of the passer-by.

Basswood is the softest hardwood and in its qualities is similar to yellow poplar and aspen. This wood is stiff, light, weak, and non-durable, with an intermediate grain, wide sapwood scarcely distinguishable, and a lack of taste and odor. It is more easily worked than any of the other hardwoods, with the probable exception of yellow poplar, does not warp or check, is tough, and takes paint well. It is used by thirty-one of the wood-using factories, besides being preferred by slack coopers over all other woods for heading, particularly flour and sugar barrels.

Table 27.—Consumption of Basswood, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Furniture,	3,945,400	21.10	$35 13	$138,592	1,105,400	2,840,000
Boxes and crates, packing,	2,936,400	15.70	16 93	49,708	1,324,400	1,612,000
Planing mill products,	2,738,576	14.65	30 97	84,811	1,396,900	1,341,676
Toys,	1,404,000	7.51	40 80	57,286	560,000	844,000
Trunks and valises,	1,374,500	7.35	27 80	38,209	754,500	620,000
Woodenware and novelties,	944,000	5.05	24 26	22,905	228,500	715,500
Frames and moulding, picture,	902,000	4.82	23 09	20,825	352,000	550,000
Excelsior,	749,000	4.00	13 77	10,315	749,000	....
Boxes, cigar,	495,000	2.65	64 95	32,150	....	495,000
Vehicles and vehicle parts,	477,850	2.55	30 10	14,384	258,500	219,350
Laundry appliances,	437,000	2.34	32 52	14,210	108,500	328,500
Dairymen's, poulterers' and apiarists' supplies,	370,000	1.98	18 00	6,660	....	370,000
Car construction,	366,010	1.96	40 74	14,911	140,214	225,796
Ladders,	275,000	1.47	29 18	8,025	150,000	125,000
Instruments, musical,	271,500	1.45	42 36	11,500	11,000	260,500
Fixtures,	269,100	1.44	33 92	9,128	176,100	93,000
Baskets, fruit and vegetable,	220,000	1.18	20 18	4,440	220,000	....
Ship and boat building,	150,000	.80	16 00	2,400	150,000	....
Agricultural implements,	80,000	.43	31 06	2,485	30,000	50,000
Brushes,	42,300	.22	34 96	1,479	42,300	....
Handles,	41,200	.22	29 73	1,225	41,200	....
Pulleys and conveyors,	40,000	.21	20 00	800	40,000	....
Rollers and poles,	37,500	.20	20 00	750	37.500	....
Boot and shoe findings,	35,500	.19	50 73	1,801	18,000	17,500
Chairs and chair stock,	33,000	.18	22 12	730	25,000	8,000
Refrigerators and kitchen cabinets,	21,600	.12	31 11	672	1,600	20,000
Manual training practice (sloyd),	14,400	.08	43 06	590	7,650	6,750
Whips, canes, and umbrella sticks,	12,500	.07	32 48	406	5,000	7,500
Machine construction,	8,500	.04	36 47	310	500	8,000
Clocks,	5,000	.03	60 00	300	....	5,000
Machinery and apparatus, electrical,	2,000	.01	55 60	111	....	2,000
Total,	18,698,836	100.00	$29 53	$552,118	7,933,764	10,765,072

BIRCHES.

Three species of birch are of commercial importance in Pennsylvania. They are sweet or cherry birch, in Pennsylvania often called black birch *(Betula lenta)*, well distributed throughout the State; yellow birch *(Betula lutea)*, found mainly on altitudes associated with beech, maple, ash, and elm; and that called red or river birch *(Betula nigra)*, of little commercial importance, inhabiting the banks of streams and rivers in all parts of the State. In 1912, the cut of birch in Pennsylvania exceeded by nearly 8,000,000 feet the quantity of State-grown lumber reported by the manufacturers, these factories drawing forty-three per cent. of their requirements from the producing regions of other States, principally New York and Vermont. Sweet birch lumber can be identified by the fact that its sapwood is nearly white and its heartwood red or nearly black. It is a fine wood, hard and strong, easily worked, takes a high polish, due, it is claimed, to the bright lining of the wood cells, and takes stains readily, which allows its use in imitation of more expensive cabinet woods. It has an intermediate grain, is hard, dense, heavy, moderately stiff, tough and durable, rather difficult to season, hard to split, and rather easy to work. Curly birch is an accidental structure in the wood, due to cross grain corresponding to the similarly figured maples and is highly prized by cabinet makers and manufacturers of high class furniture. Yellow birch is also an excellent wood. Much of it is marketed with sweet birch without distinction. In Pennsylvania it was not possible to determine to what extent the two woods were desired for similar purposes, or for what uses the manufacturers preferred the one to the other; so accordingly they have been presented in this report under one name.

In vehicle making birch bolts are used extensively in competition with elm for hubs, and it is in this industry that the red or river birch finds its chief market. Birch lumber cut from river birch is usually of low grade and most of that used in Pennsylvania was reported by the box makers, who used birch of all species in larger amounts than any other industry. The planing mills and fixture makers demanded birch for interior trim in imitation of mahogany, and the furniture makers called for it for the same reason because it is the nearest approach to mahogany of any of the domestic woods.

Table 28.—Consumption of Birch, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Tota cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing,	5,999,000	32.19	$16 76	$100,556	2,488,500	3,510,500
Planing mill products,	4,493,442	24.11	39 84	179,033	2,138,844	2,354,598
Vehicles and vehicle parts,	1,514,500	8.13	48 11	72,864	455,000	1,059,500
Furniture,	1,138,270	6.11	29 10	33,126	525,900	612,370
Laundry appliances,	1,090,000	5.85	12 72	13,860	1,070,000	20,000
Chairs and chair stock,	992,400	5.33	30 05	29,824	583,500	408,900
Fixtures,	832,300	4.47	36 60	30,461	438,500	393,800
Toys,	617,000	3.31	23 84	14,708	617,000	....
Woodenware and novelties,	466,500	2.50	25 95	12,105	230,000	236,500
Mine equipment,	336,075	1.80	24 23	8,143	336,075	....
Car construction,	312,845	1.68	28 86	9,029	231,045	81,800
Handles,	207,750	1.11	18 13	3,766	205,250	2,500
Dairymen's, poulterers' and apiarists' supplies,	100,000	.54	18 00	1,800	100,000	....
Plumbers' woodwork,	95,000	.51	30 95	2,940	75,000	20,000
Instruments, musical,	90,000	.48	23 89	2,150	50,000	40,000
Baskets, fruit and vegetable,	70,000	.38	22 43	1,570	70,000	....
Refrigerators and kitchen cabinets,	65,000	.35	25 15	1,635	30,000	35,000
Brushes,	51,000	.27	14 02	715	51,000	....
Pumps,	50,000	.27	17 00	850	50,000	....
Printing material,	30,000	.16	50 00	1,500	10,000	20,000
Agricultural implements,	20,000	.11	24 00	480	20,000	....
Rollers and poles,	12,000	.06	14 00	168	12,000	....
Pulleys and conveyors,	10,000	.05	20 00	200	10,000	....
Frames and moulding, picture,	7,500	.04	75 00	562	....	7,500
Clocks,	4,000	.02	45 00	180	....	4,000
Machine construction,	3,000	.02	25 00	75	3,000	....
Pipes, tobacco,	2,000	.01	50 00	100	....	2,000
Caskets and coffins,	1,000	.01	24 00	24	1,000	....
Miscellaneous,	25,000	.13	14 00	350	25,000	....
Total,	18,635,582	100.00	$28 05	$522,774	9,826,614	8,808,968

THE HICKORIES.

Two industries in Pennsylvania, vehicle parts and handles, together use nearly five-sixths of the 18,000,000 feet of hickory going into products of final manufacture. The remainder is divided in varying small amounts among eighteen industries, of which car building, making of mine sprags, and machine construction are the principal ones. On account of the variety of special uses for which hickory is demanded, a large amount of waste is occasioned, both in the preparation of the raw material as well as in the finished commodity. This waste probably exceeds that of any other valuable hardwood.

Six species of hickory grow in Pennsylvania and some of them are found more or less generally throughout the State. In the tree they can be readily identified by their botanical characteristics, but when cut into lumber the species are difficult to distinguish. The information available to guide in their separation was so meager that they are therefore presented in this report under the generic name hickory. The growing scarcity of hickory, together with the fact that no suitable substitutes have been found for it in a number of its special uses, accounts for the high average price the manufacturers paid for it. Apart from its scarcity, the wood is a most valuable one, owing to its combination of qualities of extraordinary hardness, strength, toughness, and flexibility. No such combination exists in any other domestic hardwood. Further, it has a straight grain, is moderately elastic, hard to split, and very perishable; it is a difficult wood to season and to work and to be made to hold its shape.

Table 29.—Consumption of Hickory, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Vehicles and vehicle parts, ..	10,819,552	60.60	$48 51	$524,895	3,642,252	7,177,300
Handles, ...	3,973,350	22.26	31 97	127,045	2,599,300	1,374,050
Car construction, ...	1,115,306	6.25	24 50	27,325	343,697	771,609
Mine equipment, ...	816,363	4.57	13 51	11,031	816,363	....
Machine construction, ...	699,000	3.91	27 27	19,063	643,000	56,000
Agricultural implements, ...	124,400	.70	33 41	4,156	99,400	25,000
Planing mill products, ...	80,100	.45	27 03	2,165	70,100	10,000
Shuttles, spools, and bobbins, ..	63,000	.35	46 98	2,960	30,000	33,000
Butchers' blocks and skewers, ..	50,000	.28	18 00	900	50,000	....
Ship and boat building, ...	28,000	.16	65 00	1,820	26,500	1,500
Whips, canes, and umbrella sticks, ...	26,000	.15	55 85	1,452	....	26,000
Ladders, ...	25,000	.14	18 00	450	25,000	....
Chairs and chair stock, ...	15,000	.08	17 20	258	15,000	....
Saddles and harness, ...	10,000	.06	60 00	600	....	10,000
Rollers and poles, ...	2,500	.01	60 00	150	2,500	....
Woodenware and novelties, ...	2,500	.01	60 00	150	2,500	....
Fixtures, ...	1,000	.01	65 00	65	1,000	....
Manual training practice (sloyd), ...	934	.01	70 66	64	234	700
Furniture, ...	750	......	81 33	61	250	500
Printing material, ...	500	......	50 00	25	500	....
Total, ...	17,853,255	100.00	$40 59	$724,635	8,367,596	9,485,659

THE ASHES.

Ash is one of the most widely distributed of the North American trees. It ranges from the Rocky Mountain states eastward through every state but Maine, and the fact that 606 Pennsylvania sawmills in 1912 reported cutting this wood, indicates that the tree is also well distributed throughout this State. Manufacturers do not distinguish the species for particular uses but, like the oaks, they separate them into classes, white ash and black ash. In Pennsylvania the white ash *(Fraxinus americana)* and black ash *(Fraxinus nigra)* are the most important commercial species of ash growing within the State and they make up the bulk of the material which the Pennsylvania manufacturers consume. The white ash is one of Pennsylvania's valuable hardwoods. It possesses a coarse, straight grain, fine texture, is moderately hard and strong, besides being rather resilient and tough. However, it lacks durability. The manufacture of vehicle parts, handles, agricultural implements, boats, sporting goods, and framework of various kinds where the qualities of strength and toughness are desired call principally for white ash, both in Pennsylvania and the country at large.

The uses of black ash are quite different from those of the white ash because of its different qualities. It is much softer, not as strong or as elastic, and is more durable. Black ash has a pronounced attractive figure and is more desirable for decorative work. It is, therefore, called on to meet large demands for interior finish of houses, railroad and trolley cars. The lack of taste and odor makes ash valuable for containers of foodstuffs, such as butter tubs, woodenware, flour barrels, and boxes of various kinds. Only forty-six per cent. of the ash going into further manufacture was State-grown, in spite of the fact that the lumber cut exceeded by over 4,000,000 feet the amount of home-grown material used.

Table 30.—Consumption of Ash, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Car construction,	4,396,915	30.74	$56 70	$249,311	933,908	3,463,007
Vehicles and vehicle parts,	3,590,472	25.10	44 16	158,564	2,096,204	1,494,268
Handles,	1,969,750	13.77	28 45	56,032	1,130,750	839,000
Planing mill products,	791,315	5.53	51 89	41,062	533,165	258,150
Woodenware and novelties,	634,500	4.43	30 67	19,462	259,500	375,000
Agricultural implements,	599,100	4.19	38 73	23,202	103,100	496,000
Dairymen's, poulterers' and apiarists' supplies,	400,000	2.80	15 00	6,000	395,000	5,000
Ship and boat building,	388,700	2.72	41 47	16,118	262,700	126,000
Toys,	320,000	2.24	42 03	13,450	182,500	137,500
Furniture,	175,500	1.23	28 43	4,989	82,500	93,000
Plumbers' woodwork,	110,000	.77	34 00	3,740	....	110,000
Chairs and chair stock,	104,300	.73	24 54	2,559	37,300	67,000
Saddles and harness,	100,000	.70	44 80	4,480	76,000	24,000
Elevators,	93,000	.65	71 17	6,619	43,600	49,400
Trunks and valises,	87,500	.61	36 42	3,187	87,500	....
Machine construction,	83,000	.58	44 88	3,725	5,000	78,000
Equipment, playground,	75,000	.52	33 00	2,475	37,500	37,500
Boxes and crates, packing,	54,200	.38	23 51	1,274	53,500	700
Fixtures,	49,900	.35	58 62	2,925	41,000	8,900
Mine equipment,	43,425	.30	22.01	956	43,425	....

Table 30—Concluded.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Refrigerators and kitchen cabinets,	32,000	.22	38 19	1,222	4,000	28,000
Baskets, fruit and vegetable,	30,000	.21	21 00	630	30,000	....
Sporting and athletic goods,	30,000	.21	66 83	2,005	30,000	....
Machinery and apparatus, electrical,	25,000	.17	60 00	1,500	....	25,000
Instruments, professional and scientific,	15,000	.10	58 67	880	5,000	10,000
Pulleys and conveyors,	15,000	.10	30 00	450	7,000	8,000
Brushes,	12,600	.09	34 29	432	12,600	....
Frames and moulding, picture,	10,000	.07	35 00	350	10,000	....
Rollers and poles,	6,150	.04	32 68	201	5,000	1,150
Instruments, musical,	5,300	.04	44 34	235	5,000	300
Ladders,	4,000	.03	70 00	280	4,000	....
Manual training practice (sloyd),	1,100	.01	70 91	78	300	800
Laundry appliances,	1,000	.01	25 00	25	1,000	....
Weighing apparatus,	900	.01	93 06	84	900	....
Miscellaneous,	50,000	.35	25 00	1,250	50,000	....
Total,	14,304,627	100.00	$44 02	$629,752	6,568,952	7,735,675

45.92% in. 54.08% out.

THE ELMS.

Only two species of elm were reported by the Pennsylvania wood users, white elm *(Ulmus americana)* and cork elm *(Ulmus racemosa)*; but it is possible that small quantities of slippery elm *(Ulmus pubescens)=(U. fulva)* were used, but because it is cut in this State in only small quantities it is usually marketed mixed with white elm and, therefore, was not identified and reported separately. Cork elm is the most valuable of the three elms because the wood is most durable, but white elm in Pennsylvania is the most abundant species and composes the largest proportion of the 3,000,000 feet of elm that the Pennsylvania sawmills cut in 1912. Elm, irrespective of species, is one of the strongest and most elastic hardwoods growing in Pennsylvania. In addition to being heavy, tough, hard, and dense, it is hard to work and difficult to season. The two species reported are together demanded by 16 industries. The largest amount of the cork elm went to the vehicle maker, while the chair industry was foremost in demanding the white elm. The trunk makers also bid for a large amount of this wood for slat material.

Table 31.—Consumption of Elm*, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Chairs and chair stock, ...	6,213,500	59.85	$26 76	$166,243	62,000	6,151,500
Trunks and valises, ...	1,837,500	17.70	30 82	56,625	250,000	1,587,500
Dairymen's, poulterers' and apiarists' supplies, ...	600,000	5.78	25 00	15,000	250,000	350,000
Woodenware and novelties, ...	500,000	4.83	28 00	14,000	....	500,000
Vehicles and vehicle parts, ...	484,400	4.67	35 92	17,398	95,800	388,600
Boxes and crates, packing, ...	429,800	4.14	24 20	10,400	132,300	297,500
Baskets and veneer packages for fruit and vegetables, ...	115,000	1.11	21 87	2,515	115,000	....
Car construction, ...	63,343	.61	49 43	3,131	....	63,343
Agricultural implements, ...	50,000	.48	25 00	1,250	50,000	....
Elevators, ...	32,500	.31	64 98	2,112	20,500	12,000
Toys, ...	25,000	.24	21 00	525	12,500	12,500
Patterns and flasks, ...	15,000	.14	33 00	495	....	15,000
Mine equipment, ...	8,800	.08	26 14	230	8,800	....
Planing mill products, ...	4,000	.04	23 00	92	4,000	....
Machine construction, ...	2,000	.02	50 00	100	....	2,000
Total, ...	10,380,843	100.00	$27 95	$290,116	1,000,900	9,379,943
					9.64% in.	90.36% out.

*The white and cork elm groups have been combined in this table. In Part II of this report the information is given separately.

COTTONWOOD.

(Populus deltoides).

Cottonwood belongs to a widely distributed tree family, which includes the willows, aspen, balm of gilead, and other poplars (not yellow poplar). The cottonwood referred to in this report is the *Populus deltoides*, the tree found in large sizes and most abundant in the lower Mississippi Valley. It grows in moist soil in almost all the states east of the Rocky Mountains. Owing to the difficulty in seasoning cottonwood, it is better adapted for veneer than lumber. Yellow and white cottonwood are often distinguished in trade. The former refers to the heartwood, the latter to the light colored sapwood of the tree. However, the amount consumed for veneer production in the United States is only about 10 per cent. of the lumber cut. The manufacturers of built up lumber used this wood in large amounts as veneer. On account of its qualities of toughness, flexibility, and its capacity for being easily worked, it is especially adapted for bent work as in vehicle bodies and auditorium chairs. It is also popular with trunk makers for trunk boxes and tops. The lumber serves many uses as a substitute for basswood and yellow poplar, and, like these woods, is light, weak, and non-durable; but of fine even texture and a lack of taste and odor. The last two named qualities commend it as a material for food containers, while for packing cases and crates its other excellent qualities, combined with its whitish color, make it especially desirable as a background for printing and stenciling. This tree is not commonly cut in Pennsylvania, which accounts for the fact that only about one and one-half per cent. of the total amount used was State-grown. Eleven industries together demand over six and one-third million feet of cottonwood, of which 74 per cent. is used by the box industry, nearly 8 per cent. for laundry appliances, and 6 per cent. by the furniture makers.

Table 32.—Consumption of Cottonwood, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing, ...	4,680,000	73.86	$24 60	$115,135	40,000	4,640,000
Laundry appliances, ...	500,000	7.89	32 90	16,450	....	500,000
Furniture, ...	380,000	6.00	34 87	13,250	....	380,000
Planing mill products, ...	330,000	5.21	25 36	8,370	....	330,000
Trunks and valises, ...	177,350	2.80	37 95	6,731	....	177,350
Refrigerators and kitchen cabinets, ...	150,000	2.37	32 00	4,800	....	150,000
Vehicles and vehicle parts, ...	64,000	1.01	34 38	2,200	24,000	40,000
Fixtures, ...	40,000	.63	38 50	1,540	20,000	20,000
Sporting and athletic goods, ..	10,000	.16	32 00	320	....	10,000
Dairymen's, poulterers' and apiarists' supplies, ...	2,500	.04	40 00	100	2,500	....
Pulleys and conveyors.	2,000	.03	21 00	42	2,000	....
Total, ...	6.335,850	100.00	$26 66	$168,938	88,500	6,247,350

THE GUMS.

Black gum is the common name given in various states to three trees, black or sour gum *(Nyssa sylvatica)*, cotton gum or tupelo *(Nyssa aquatica)*, and water gum *(Nyssa biflora)*, all belonging to the dogwood family. Red gum, though it bears the name of "gum" does not belong to the same family and, therefore, has been discussed under a separate heading. One of the above named species, the black or sour gum, grows within the State. It is found in wet lowlands and along the slopes of the foothills and mountains. It is not abundant and only a little over 5 per cent. of the total of nearly 5,000,000 feet used by 11 industries is State-grown wood. It attracts attention by its bright green summer foliage, which in the autumn turns to brilliant yellow and red, and also by its clusters of two or three oblong berries of bluish black color and sour taste. The wood of this tree has an interlaced fiber and is difficult to split and work; hence it is valuable for certain special uses, such as vehicle hubs, pulleys, mine rollers, mauls, mallets, and cogs. In the South it is cut into veneer and goes into wooden dishes, berry cups, fruit baskets, and veneer boxes.

Table 33.—Consumption of Black Gum., year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates, packing,	3,089,800	62.33	$15 36	$47,463	....	3,089,800
Mine equipment,	1,628,460	32.85	24 37	39,678	219,216	1,409,244
Vehicles and vehicle parts,	181,800	3.67	37 57	6,831	31,500	150,300
Baskets, fruit and vegetable,	20,000	.41	22 00	440	20,000	....
Pulleys and conveyors,	14,000	.28	33 71	472	....	14,000
Instruments, professional and scientific,	12,000	.24	52 83	634	2,000	10,000
Rollers and poles,	6,000	.12	20 00	120	....	6,000
Ship and boat building,	3,000	.06	70 00	210	....	3,000
Fixtures,	1,000	.02	28 00	28	....	1,000
Car construction,	600	.01	58 00	35	....	600
Patterns and flasks,	500	.01	24 00	12	....	500
Total,	4,957,160	100.00	$19 34	$95,923	272,716	4,684,444

Cotton Gum (Nyssa aquatica).

Most of the cotton gum or tupelo lumber came from Virginia and the Carolinas. It grows only on the swamps and lowlands and in lumber can be distinguished from the black (sour) gum by its darker yellowish hue, its tendency to split straight, besides being soft and more easily worked. Nearly 6,000,000 feet of this wood is demanded by eight industries. The box makers use most of it. Cigar box material also claims a fairly large amount. The two industries together consume 92 per cent. of the total.

Table 34.—Consumption of Cotton Gum, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boxes and crates,	3,458,722	58.05	$14 13	$48,873	....	3,458,722
Boxes, cigar,	2,043,917	34.31	63 37	129,519	....	2,043,917
Furniture,	236,500	3.97	33 54	7,933	....	236,500
Planing mill products,	151,648	2.54	26 55	4,027	....	151,648
Agricultural implements,	35,000	.59	36 00	1,260	....	35,000
Instruments, musical,	20,000	.34	25 00	500	....	20,000
Woodenware and novelties,	6,900	.12	20 00	138	....	6,900
Toys,	5,000	.08	20 00	100	....	5,000
Total,	5,957,687	100.00	$32 29	$192,350	....	5,957,687

CHERRY.

(Prunus serotina).

In the lumber cut of cherry, Pennsylvania is second only to West Virginia. Notwithstanding the fact that the production of cherry in Pennsylvania is nearly 5,000,000 feet more than the consumption, one-third of the requirements of the manufacturers was supplied by the forests of other states. Black cherry is the only cherry species used commercially. Its technical quality is high in that it combines strength and hardness, a fine straight grain, compact structure, and stability. It also takes a fine polish and excels most other hardwoods in its capacity to hold its shape. It is this quality which commends it for electrotype backing. In Pennsylvania this is its chief use. The car manufacturers give it preference over any other domestic wood for the best grade interior finish of passenger coaches. It is a favorite with the fixture and furniture manufacturers. The qualities, in addition to those mentioned above, are durability, stiffness, density, and ease in splitting. It is somewhat brittle, with a fine, straight grain.

Table 35.—Consumption of Black Cherry, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Printing material,	1,166,800	42.84	$29 14	$34,003	634,000	532,800
Brushes,	482,900	17.73	25 43	12,282	482,900	....
Car construction,	431,414	15.84	60 59	26,140	216,951	214,463
Planing mill products,	177,385	6.51	64 48	11,438	110,085	67,300
Fixtures,	128,700	4.73	66 14	8,512	83,250	45,450
Furniture,	113,900	4.18	34 74	3,957	105,600	8,300
Patterns and flasks,	86,894	3.19	71 58	6,220	54,644	32,250
Boxes and crates, packing,	70,000	2.57	19 00	1,330	70,000	....
Caskets and coffins,	20,000	.73	60 00	1,200	20,000	....
Instruments, professional and scientific,	10,000	.37	100 00	1,000	....	10,000
Handles,	7,500	.28	50 00	375	2,500	5,000
Refrigerators and kitchen cabinets,	7,500	.28	62 50	469	7,500	....
Weighing apparatus,	7,500	.28	27 00	202	7,500	....
Instruments, musical,	4,400	.16	75 68	333	3,600	800
Plumbers' woodwork,	4,400	.16	94 55	416	400	4,000
Vehicles and vehicle parts,	2,250	.08	91 56	206	2,000	250
Manual training practice (sloyd),	1,850	.07	55 68	103	1,850	....
Sporting and athletic goods,	100	......	46 00	5	100	....
Total,	2,723,493	100.00	$39 73	$108,191	1,802,880	920,613

BLACK WALNUT.

(Juglans nigra).

The cut of black walnut in Pennsylvania is equal to three times the total consumed by the factories and five times the quantity of the home grown wood that they report. Black walnut is the most expensive hardwood native to Pennsylvania and was demanded by 17 industries. It is very durable, easy to work, hard, porous, strong, stiff, heavy, stable in place, non-elastic, and with an intermediate straight grain. The makers of caskets and coffins used the most, followed by the manufacturers of organs and furniture, using nearly equal quantities, and by 14 other industries demanding varying smaller amounts.

Table 36.—Consumption of Black Walnut, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Caskets and coffins,	214,000	27.35	$59 50	$12,732	182,000	32,000
Instruments, musical,	131,200	16.77	44 05	5,779	67,700	63,500
Furniture,	130,000	16.61	95 04	12,365	21,000	109,100
Planing mill products,	77,265	9.87	111 31	8,600	52,365	24,900
Car construction,	56,890	7.27	101 13	5,753	980	55,910
Chairs and chair stock,	50,000	6.39	66 08	3,304	44,000	6,000
Fixtures,	35,860	4.58	82 91	2,973	28,860	7,000
Clocks,	21,000	2.68	50 95	1,070	21,000	....
Patterns and flasks,	14,500	1.85	50 00	725	4,500	10,000
Frames and mouldings, picture,	10,500	1.34	80 67	847	4,500	6,000
Machinery and apparatus, electrical,	2,500	.32	40 00	100	2,500	....
Vehicles and vehicle parts,	1,400	.18	91 42	128	1,100	300
Handles,	1,050	.14	81 90	86	1,050	....
Brushes,	1,000	.13	80 00	80	1,000	....
Manual training practice (sloyd),	850	.11	87 06	77	650	200
Plumbers' woodwork,	300	.04	35 00	10	300	....
Miscellaneous,	34,200	4.37	71 81	2,456	10,200	24,000
Total,	782,615	100.00	$72 94	$57,085	443,705	338,910

SYCAMORE.

(Platanus occidentalis).

Not more than 4½ per cent. of the requirements of the Pennsylvania wood-users was drawn from the State-grown sycamore. This is not surprising, as this species is not an important lumber tree in this State. Sycamore's fine grain revealed by rift sawing and its rich color commend its use for cabinet work. It has a coarse, distinct grain, somewhat contorted, and is hard, heavy, stiff, hard to split, moderately strong and durable, difficult to season and to work, and unstable in holding its shape. Forty-two mills report it, but only in small quantities. Probably the most exacting use of this wood in the country at large is for butcher blocks, but in Pennsylvania none of the manufacturers report using it for that purpose. The chair makers demanded the most that was used, almost 72 per cent. of the total, while the rest was about equally distributed among five other industries, the brush makers being the most important.

Table 37.—Consumption of Sycamore, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Chairs and chair stock, ...	500,000	71.73	$25 00	$12,500	....	500,000
Brushes, ...	71,000	10.19	26 00	1,846	....	71,000
Furniture, ...	66,170	9.49	43 89	2,904	3,000	63,170
Planing mill products, ...	28,300	4.06	45 72	1,294	17,000	11,300
Ship and boat building, ...	20,000	2.87	65 00	1,300	....	20,000
Boxes and crates, packing, ...	11,603	1.66	16 00	186	11,603	....
Total, ...	697,073	100.00	$28 73	$20,030	31,603	665,470

HORNBEAM.

(Ostrya virginiana).

Hornbeam is frequently called ironwood because of its great weight and strength. It has an intermediate grain, is somewhat contorted, is very hard and dense, tough, stiff, durable, and difficult to split, besides being heavy, difficult to season and hard to work, but capable of wearing smooth by use. The wood being heavy, tough, and resilient, is used extensively by the handle makers and the manufacturers of vehicle parts. Its other uses in this State are for mine sprags and for sides of cheese boxes. It is possible that the material reported for the last named use may have been blue beech *(Carpinus caroliniana)*, which is also called ironwood and closely resembles hornbeam. Nearly three-fourths of the total amount of the material that is used was supplied by the State, while of that coming from a distance a part was supplied by Canadian forests.

Table 38.—Consumption of Hornbeam, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Handles, ...	415,500	75.93	$49 53	$20,580	315,500	100,000
Vehicles and vehicle parts, ...	100,000	18.28	30 00	3,000	50,000	50,000
Mine equipment (sprags), ...	21,684	3.96	13 14	285	21,684	....
Dairymen's, poulterers', and apiarists' supplies, ...	10,000	1.83	12 00	120	10,000	....
Total, ...	547,184	100.00	$43 83	$23,985	397,184	150,000

BLACK LOCUST.

(Robinia pseudacacia=R. Pseudo-Acacia).

All the black locust used by the Pennsylvania manufacturers was grown in the State, and in quantity was equal to more than one-tenth of the total lumber cut of locust in the United States. This was because the wood is demanded for uses which usually require raw material in the forms of billets and bolts, and it is an exception that it leaves the sawmills in the form of planks or boards. Only three industries use this wood in Pennsylvania and two of them cut it into billet form. They are the makers of insulator pins, brackets, and mine sprags. The third industry, vehicle part manufacture, purchases locust in bolt form and uses it for wagon hubs. This species has the distinction of being the most durable native hardwood both in the open when exposed and in contact with the ground, thus accounting for its extensive demand for fence posts. It has a coarse, straight grain, is hard, porous, heavy, and tough, splits easily, holds its shape well, and easily turned.

Table 39.—Consumption of Black Locust, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Insulator pins and brackets, ...	463,500	91.63	$23 90	$11,076	463,500	....
Mine equipment (sprags), ...	31,350	6.20	10 18	319	31,350	....
Vehicles and vehicle parts, ...	11,000	2.17	18 73	206	11,000	....
Total, ...	505,850	100.00	$22 93	$11,601	505,850	....

CUCUMBER.

(Magnolia acuminata).

This tree frequents the mountain slopes and grows to large and symmetrical dimensions. It is a member of the magnolia family, which includes the yellow poplar. It derives its name from the similarity in form and appearance of its fruit cone to the cucumber. The appearance and technical quality of the wood so resemble yellow poplar and the uses of the two are so nearly identical that as a rule they are marketed together without distinction. Owing to this fact it is probable that the manufacturers use more cucumber than the table shows, and it also accounts for Pennsylvania's not being included with West Virginia and Virginia in the production of this kind of lumber. The principal industries using this wood are planing mill products and boxes.

Table 40.—Consumption of Cucumber, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products, ...	267,300	76.07	$27 00	$7,217	255,300	42,000
Boxes and crates, ...	70,000	19.92	17 00	1,190	....	70,000
Pulleys and conveyors, ...	10,000	2.85	18 00	180	10,000	....
Vehicles and vehicle parts, ...	3,800	1.08	25 00	95	....	3,800
Agricultural implements, ...	300	.08	30 00	9	300	....
Total, ...	351,400	100.00	$24 73	$8,691	235,600	115,800

BUCKEYE.

Buckeye, like cucumber, often loses its identity and goes to market mixed with yellow poplar. It is called for separately by the manufacturers of artificial limbs to meet what may probably be termed its most exacting use, but for this purpose was not reported in Pennsylvania. The wood is light, soft, cross grained, compact, and difficult to split. The color is creamy white and so uniform that the sapwood can hardly be distinguished from the heartwood. Two species of buckeye are native to Pennsylvania, the fetid buckeye *(Aesculus glabra)* and the yellow or sweet buckeye *(Aesculus octandra)*. The western part of this State is the eastern limit of both species and it is impossible to ascertain the quantity of each that the manufacturers use. This wood is more evenly distributed among the various classes of manufacture calling for it than any other shown in this report.

Table 41.—Consumption of Buckeye, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Laundry appliances, ...	125,000	38.56	$28 00	$3,500	125,000	....
Woodenware and novelties, ...	83,700	25.82	25 00	2,093	....	83,700
Boxes and crates, packing, ...	80,500	24.83	22 99	1,851	40,000	40,500
Planing mill products, ...	35,000	10.79	20 71	725	19,000	16,000
Total, ...	324,200	100.00	$25 19	$8,168	184,000	140,200

APPLEWOOD.

(Pyrus species).

This wood may be of many species and is consumed in larger quantities in Pennsylvania than in any other state in which reports similar to this have been made. It is demanded for a few special purposes, the manufacture of smoking pipes being the most important, while under the heading of printing material, it is used for wood type. As in other states, it is used for making carpenters' tools, particularly handsaw handles.

Table 42.—Consumption of Applewood, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Pipes, smoking,	121,435	70.42	$52 42	$6,372	61,435	60,000
Handles,	50,000	29.00	40 00	2,000	25,000	25,000
Handles,	1,000	.58	50 00	50	1,000	....
Total,	172,435	100.00	$48 84	$8,422	87,435	85,000

DOGWOOD.

(Cornus florida).

Nearly all of the dogwood going into final manufacture in Pennsylvania was grown in the State. It is exceedingly hard, strong, of compact structure, and tough, and these qualities together with its ability to wear smooth give it preference over any other wood in the manufacture of shuttles, and commend it for mine sprags. These two industries use 95 per cent. of the total amount reported. Three other industries use the remainder.

Table 43.—Consumption of Dogwood, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Mine equipment (sprags),	139,088	84.74	$15 73	$2,188	139,088	....
Shuttles, spools, and bobbins,	17,585	10.71	69 60	1,224	....	17,585
Instruments, scientific and professional,	7,200	4.39	38 47	277	1,000	6,200
Handles,	230	.14	67 57	16	....	230
Manual training practice (sloyd),	34	.02	90 00	3	34	....
Total,	164,137	100.00	$22 59	$3,708	140,122	24,015

PERSIMMON.

(Diospyros virginiana).

The persimmon tree belongs to the ebony family which is confined largely to tropical regions. The wood has all the good qualities of ash, works more smoothly, and retains a friction polish. Besides it has a very fine, rather straight grain, and is hard, strong, tough, porous, very heavy, and splits easily. Persimmon has two important uses for which there is extensive demand, last-blocks for children's shoes, and shuttles used in textile mills. In the country at large, the greatest quantity probably goes to the latter industry, but in Pennsylvania the makers of boot and shoe findings used all but 12½ per cent. of the quantity consumed.

Table 44.—Consumption of Persimmon, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Boot and shoe findings, ...	99,000	87.60	$59 19	$5,860	....	99,000
Shuttles, spools and bobbins, ..	7,010	6.20	60 06	421	....	7,010
Handles, ...	7,000	6.20	54 00	378	....	7,000
Total, ...	113,010	100.00	$58 92	$6,659	....	113,010

BUTTERNUT.

(Juglans cinerea).

Butternut is relatively common on good soil in Pennsylvania. It is used by a greater number of industries in this State than in any other. Nearly 92 per cent. of the total quantity used in Pennsylvania is grown in the State. The most surprising fact in connection with the use of this wood is the consumption of butternut for excelsior at the low price of $15 per thousand feet. The excelsior makers used more than one-third of all reported, while the fixture manufacturers, the ship builders, and the manufacturers of pulleys were the next in importance, these four industries together consuming 74 per cent. of the total. The rest went to four other industries in varying small amounts. Butternut is often called white walnut. Its qualities include porousness, brittleness, stiffness, lack of resiliency, capacity to split, easy to work, and it is considerably lighter, weaker, and less durable than black walnut.

Table 45.—Consumption of Butternut, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Excelsior,	30,000	34.56	$15 00	$450	30,000	....
Fixtures,	13,500	15.55	44 30	598	13,500	....
Ship and boat building,	10,000	11.52	80 00	800	7,000	3,000
Pulleys and conveyors,	10,000	11.52	20 00	200	10,000	....
Planing mill products,	9,600	11.06	30 21	290	6,600	3,000
Patterns and flasks,	5,210	6.00	79 85	416	3,900	1,310
Boxes and crates, packing,	5,000	5.76	16 00	80	5,000	....
Furniture,	3,500	4.03	26 61	93	3,500	....
Total,	86,810	100.00	$33 72	$2,927	79,500	7,310

MINOR SPECIES.

Domestic woods used in only small amounts, and not of sufficient importance to discuss separately, are as follows: Holly (American), used by the novelty makers, brought in from the southern Mississippi Valley; State-grown aspen (popple), used for excelsior; willow for woodenware, likewise produced in the State; home-grown mountain laurel used by the furniture makers; and sassafras cut in Maryland and purchased by the ship builders.

FOREIGN WOODS.

This term is employed to cover all woods brought into Pennsylvania from foreign countries other than Canada. There are ten of them and Spanish cedar in quantity is the most important.

Only two states have shown so large a consumption of Spanish cedar as Pennsylvania. Nearly 6,000,000 feet is consumed annually and comes principally from the West Indies and Mexico. This tree is not a softwood like the native cedars, nor is it related. It has broad leaves, confining its range to the tropical countries. Its aromatic odor, pleasing color, and lightness, together with the fact that it holds its shape and is easily worked, make it the favorite cigar box wood. Boat builders and furniture makers in Pennsylvania also report this wood in small quantities.

Over 3,500,000 feet of mahogany is brought into the State each year. The furniture makers use the largest amount, although 17 other classes of manufacturers demand it for raw material, and seven of them in quantities exceeding 100,000 feet. The supply of true mahogany comes from Mexico, the West Indies, Central America, and a few states in South America, but it was not possible in any way to ascertain which of these countries supplied the Pennsylvania factories, as mahogany lumber is purchased from American dealers who import the logs and cut them in this country.

Ebony comes next as to quantity among the imported woods and surpasses the consumption of this wood in any other state. The most is used for umbrella handles although the demand for smoking pipe material is also considerable. There are many species of ebony and they are found in various countries. Probably the kind coming from Madagascar and India is used most commonly in this country.

Boxwood comes to this country from Turkey and the West Indies. From the high average price paid for that used in Pennsylvania, it is safe to conclude that most of it was Turkish wood which is much more costly. Boxwood was imported into this State to make shuttles for silk weaving and to furnish material for wood engravings.

Teakwood, strong and very hard, and with a smooth oily texture, is imported from Ceylon, Siam, and India, and in Pennsylvania the entire supply went to two industries, ship building and patterns.

Circassian walnut grows in the mountains in southern Russia near the Black Sea. While very expensive, it is held in high favor in this country for furniture, store, office, and bar fixtures, and cabinet work. It is nearly always used as veneer with a backing or core of an inexpensive native wood.

The olive wood went to the smoking pipe manufacturers. It was brought from France in the form of billets.

Rosewood was the highest priced wood that was purchased in the form of lumber by the Pennsylvania manufacturers. It is a native of Central America and the northern states of South America.

Lignum-vitae was imported in log or in bolt form from practically the same region as rosewood. It is a wood of special value on account of its extraordinary weight and strength. Bowling balls are turned from this wood after long and careful seasoning.

The eucalyptus used in Pennsylvania comes from Australia and goes to the furniture makers. The eucalyptus grown in the United States is not valued for so many uses as is the imported wood.

Description of Qualities.

Grain: Very coarse, coarse, intermediate, fine, very fine.

Width of sapwood: Very narrow, narrow, medium, wide.

Hardness: Very hard, hard, fairly* hard, soft, very soft.

Density: Dense, fairly dense, slightly porous, porous, very porous.

Weight: Very light, light, medium, moderately* heavy, heavy, very heavy.

Strength: Very strong, strong, moderately strong, weak.

Flexibility and stiffness: Very stiff, stiff, moderately stiff, fairly flexible, flexible, very flexible.

Elasticity: Very elastic, elastic, moderately elastic, non-elastic.

Toughness and Brittleness: Very tough, tough, moderately tough, slightly brittle, brittle, very brittle.

Tendency to Split: Splits easily, splits rather easily, hard to split, very hard to split.

Durability: Very durable, durable, moderately durable, perishable, very perishable.

Stability in Holding Shape: Stable, moderately stable, unstable, very unstable.

Working Quality: Very easy to work, easy to work, fairly hard to work, hard to work.

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*Fairly and moderately have the same value in the scale of terms.

PART II.

INDUSTRIES.

The kinds of wood the Pennsylvania manufacturers demand, their botanical relations, their sources, and their qualities, have been discussed in Part I. In Part II are considered the factories using the different woods, and the processes of manufacture that they employ; the extent to which they call for them, and the uses to which they put them according to inherent qualities. For convenience the discussions are divided into classes called industries and those making similar or closely related commodities are grouped together. In Pennsylvania there are 51, and Table 46 following shows how the more than 1,100,000,000 feet of lumber yearly manufactured in the State is apportioned among them. The largest industry requires nearly 280,000,000 feet of raw material, 14 others more than 10,000,000 each, and the smallest less than 100,000. A few other industries which could not be separated because the factories composing them numbered fewer than three, have been grouped in one industry under miscellaneous. To maintain uniformity the same order in classification as has been adopted to other states has been followed in Pennsylvania. Their order has been arranged according to the total quantity used and is as follows:

Table 46.—Summary by Industries of Woods used in Pennsylvania, year ending June, 1912.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Planing mill products, ...	281,717,600	25.28	$33 46	$9,427,936	83,652,088	198,065,512
Boxes and crates, packing, ...	273,904,094	24.58	18 00	4,928,991	51,353,325	222,550,769
Car construction, ...	228,380,900	20.50	29 53	6,743,700	41,069,552	187,311,348
Furniture, ...	58,995,170	5.29	35 24	2,078,971	19,045,400	39,949,770
Chairs and chair stock, ...	33,117,000	2.97	25 80	854,412	14,406,600	18,710,400
Vehicles and vehicle parts, ..	31,801,509	2.85	42 63	1,355,655	13,482,774	18,318,735
Ship and boat building, ...	26,716,000	2.40	38 44	1,026,722	11,017,200	15,698,800
Caskets and coffins, ...	13,982,500	1.26	29 77	416,278	4,044,500	9,938,000
Mine equipment, ...	11,948,897	1.07	19 52	233,283	9,173,653	2,775,244
Fixtures, ...	11,888,220	1.07	42 25	502,323	3,685,310	8,202,910
Boards—cloth, hosiery, etc., ..	11,775,000	1.06	26 69	314,315	50,000	11,725,000
Patterns and flasks, ...	11,495,011	1.03	51 39	590,706	2,887,092	8,607,919
Handles, ...	11,014,907	.99	26 68	293,919	7,425,050	3,589,857
Laundry appliances, ...	10,795,700	.97	22 17	239,336	6,631,500	4,164,200
Boxes, cigar, ...	9,930,755	.89	92 77	921,242	24,500	9,906,255
Woodenware and novelties, ...	8,574,780	.77	23 57	202,141	5,328,625	3,246,155
Tanks and silos, ...	7,853,200	.71	36.07	283,240	150,000	7,703,200
Machine construction, ...	7,040,350	.63	29 33	206,508	3,858,200	3,182,150
Agricultural implements, ...	7,004,800	.63	32 89	230,387	2,134,000	4,870,800
Toys, ...	6,421,500	.58	28 37	182,193	5,004,300	1,417,200
Trunks and valises, ...	4,122,850	.37	29 72	122,520	1,238,000	2,884,850
Brushes, ...	4,037,090	.36	22 34	90,189	3,761,700	275,390
Shuttles, spools, and bobbins,	3,347,985	.30	27 14	90,888	1,970,000	1,377,985
Dairymen's, poulterers' and apiarists' supplies, ...	3,240,450	.29	23 82	77,188	1,326,000	1,914,450
Instruments, musical, ...	2,945,000	.26	39 38	115,982	748,200	2,196,800

Table 46—Concluded.

Industry.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Machinery and apparatus, electrical,	2,715,200	.24	31 54	85,633	456,100	2,259,100
Pumps,	2,692,000	.24	23 90	64,335	2,075,000	617,000
Baskets and veneer packages for fruit and vegetables,	2,683,000	.24	19 44	52,156	2,408,000	275,000
Frames and moulding, picture,	2,619,000	.24	25 00	65,480	1,040,500	1,578,500
Refrigerators and kitchen cabinets,	2,463,800	.22	30 73	75,720	1,002,250	1,461,550
Excelsior,	1,682,000	.15	14 28	24,016	1,682,000	....
Equipment, playground,	1,507,300	.14	28 60	43,106	497,800	1,009,500
Printing material,	1,274,326	.11	31 27	39,853	668,000	606,326
Ladders,	1,108,500	.10	29 16	32,321	251,000	857,500
Elevators,	1,008,900	.09	42 08	42,459	245,100	763,800
Whips, canes, and umbrella sticks,	882,880	.08	63 90	56,412	500,100	382,780
Plumbers' woodwork,	584,250	.05	39 43	23,035	145,700	438,550
Insulator pins and brackets,	578,500	.05	21 65	12,526	578,500	....
Butchers' blocks and skewers,	520,000	.05	20 77	10,800	520,000	....
Weighing apparatus,	393,400	.04	31 93	12,561	39,400	354,000
Instruments, professional and scientific,	326,448	.03	57 44	18,750	8,500	317,948
Pulleys and conveyors,	294,500	.03	29 30	8,629	200,500	94,000
Boot and shoe findings,	265,000	.02	56 51	14,975	18,000	247,000
Pipes, tobacco,	227,515	.02	165 49	37,651	61,435	166,080
Sporting and athletic goods,	215,150	.02	38 76	8,339	139,100	76,050
Saddles and harness,	188,000	.02	55 32	10,400	136,000	52,000
Gates and fencing,	161,340	.01	22 58	3,643	16,500	144,840
Clocks,	139,500	.01	65 08	9,078	26,000	113,500
Rollers and curtain poles,	125,575	.01	19 77	2,483	115,000	10,575
Manual Training practice (sloyd),	95,945	.01	66 44	6,375	51,875	44,070
Miscellaneous,	7,416,353	.67	26 09	193,466	7,333,703	82,650
Total,	1,114,219,650	100.00	$29 15	$32,483,227	313,683,632	800,536,018

In the consumption of wood four classes of factories in Pennsylvania lead all other states: brushes, patterns and flasks, toys, and mine equipment; in seven others the State stood second; car construction, printing material, caskets and coffins, laundry appliances, playground equipment, machine construction, and tobacco pipes. The State was third in box making and the manufacture of wooden clock cases. Excelsior factories, manufacturers of insulator pins and brackets, and the makers of butcher blocks and skewers were the only industries procuring all of their wood from the forests of the State. Nineteen others use a larger amount of State-grown than shipped-in material, leaving 29 that find the major portion of their wood supply out of the State, every industry reported the purchase of some Pennsylvania wood. It is surprising that the box makers, who use only low grades, used more shipped-in material than any other industry, while on the other hand, the handle makers, who usually seek their raw material over a wide extent of territory, procured considerably over two-thirds of their needs within the State.

Nearly $32,500,000 are annually expended by the Pennsylvania wood users for raw material. Not over 20 per cent. of this is paid for home-grown woods, leaving not less than $25,000,000, a large portion of which each year goes to other states. In a great many cases this purchase money could be expended at home, since it is quite evident that the State is not manufacturing as much of its annual cut as is possible. On the succeeding pages the several industries are considered separately in the order of the quantity of wood consumed.

PLANING MILL PRODUCTS.

The extent to which lumber is used in Pennsylvania in the manufacture of building materials is shown statistically in Table 47. This does not, of course, include large quantities of rough lumber used for construction which needs no further change than the hatchet, chisel, and saw to fit it to place on the building. The factories grouped into this industry include four classes. (1) Factories specializing in the manufacture of sash, doors, and blinds or any one of these commodities. Formerly these products were made by small mills operating in nearly every town and city in Pennsylvania doing a general planing mill business but within recent years specialty manufacturing in enormous quantities has demonstrated that these commodities can be manufactured, distributed, and sold cheaper than they can be made at home in small quantities. (2) Factories producing only planing mill products or the more universal commodities kept in stock like flooring, ceiling, siding, stock finish, etc. Planing mills operated in connection with large sawmills are the principal source of these commodities but portable mills having planers and local sash and door factories also produce large quantities. In this class are included mills specializing in the manufacture of hardwood flooring which in Pennsylvania is an important industry, also parquetry flooring. (3) There are planing mills and builders' factories engaged in the general planing mill business. This class is the most numerous and widely distributed over the State. They manufacture chiefly according to special design and usually for local consumption. Included in their production are special size sash, doors, blinds, and in small quantities floorings, ceiling, etc., besides material for window and door frames, stair work, cupboards, mantels, panel work, colonnades, grills, and all exterior and interior house finish. A number of factories belonging to this class are formidable industries, especially those located in cities. (4) Industries other than wood-using that maintain a woodworking shop equipped to manufacture various commodities like those mentioned above for their own needs and mainly for the repair and upkeep of their own plant. Steel mills, collieries, railroad companies, textile mills, and various other large manufacturing enterprises are examples.

Over 25 per cent. of the lumber cut of the United States is demanded for manufacturing products belonging to this industry and more wood and a greater number of kinds goes into this line of manufacture than into any other. It is not surprising, therefore, that these same facts apply to Pennsylvania and that in this report the planing mill industry as to quantity leads all others. The table following lists the kinds and amounts of woods used but in no manner does it represent all the lumber required in the State in this line.

Forty-four kinds of wood were reported by the factories grouped under this industry which is the largest number making up any of the forty-eight industries comprising this report. This can probably be explained by the many and varied uses of lumber for building purposes in which operations range as in Pennsylvania from the construction of a rude shanty to expensive palatial residences.

An examination of the list of woods in the table shows that a number of the species used in large amounts do not grow plentifully in the State. The Pacific coast states furnished a considerable quantity, including western white pine, western yellow pine, redwood, Douglas fir, western red cedar, Sitka spruce, and sugar pine. The region of the southern states contributed large amounts, equivalent to 34 per cent. of all, including more particularly the several species of southern yellow pine lumber and cypress. The Ohio valley, the Lake states, and New England, sent in varying amounts, which explains the comparatively small quantity of home-grown woods used by the planing mills. It must be remembered, however, a large number of these species are not common lumber trees in Pennsylvania.

Only 28 per cent. of the total amount of lumber used was produced in the State. But of the species consumed that are plentifully cut in Pennsylvania, the reports show the demand for a high per cent. of home-grown woods. For instance, over 45 per cent. of the white pine, 67 per cent. of the hemlock, one-third of the chestnut, 80 per cent. of the sugar maple and beech, 60 per cent. of the birch, and half of the basswood reported by the planing mills, were cut from State timber, indicating the importance the forests bear to the development of the State. The planing mill industry is not only the most prominent wood consuming industry in the State but it appeals more widely to the interest of every class of citizens than any other. In order that the supply of lumber the State contributes for building material may be maintained and probably increased in the future, it is necessary to protect and improve the forests as far as possible. With this in view the Commonwealth has put into effect and has in operation a progressive forest policy which if given popular support will help to solve the problem of future lumber supply.

Table 47.—Wood for Planing Mill Products, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White pine,	62,556,492	22.21	$36 53	$2,285,337	29,261,299	33,295,193
Shortleaf pine,	51,870,590	18.41	26 68	1,383,733	....	51,870,590
Hemlock,	23,077,000	8.19	21 24	490,263	15,349,900	7,727,100
Longleaf pine,	19,612,698	6.96	29 39	576,370	....	19,612,698
Cypress (bald),	18,790,200	6.67	39 68	745,612	....	18,790,200
Chestnut,	17,409,350	6.18	37 65	655,450	5,815,700	11,593,650
Yellow poplar,	17,123,372	6.08	37 38	640,042	4,127,990	12,995,382
Red oak,	16,092,048	5.71	41 73	671,551	6,483,450	9,608,598
White oak,	13,714,723	4.87	46 78	641,582	4,325,950	9,388,773
Sugar maple,	9,681,890	3.44	23 75	229,963	8,673,090	1,008,800
Loblolly pine,	7,307,090	2.59	27 52	201,076	....	7,307,090
Birch,	4,493,442	1.60	39 84	179,033	2,138,844	2,354,598
Western white pine,	2,914,500	1.03	39 55	115,281	....	2,914,500
Pitch pine,	2,826,000	1.00	22 37	63,206	2,826,000	....
Basswood,	2,738,576	.97	30 97	84,811	1,396,900	1,341,676
Beech,	2,461,750	.87	16 35	40,250	1,972,250	489,500
Spruce,	1,999,734	.71	29 96	59,904	176,350	1,823,384
Red gum,	1,610,300	.57	31 31	50,422	....	1,610,300
Sugar pine,	1,122,000	.40	48 20	54,078	....	1,122,000
Ash,	791,315	.28	51 89	41,062	533,165	258,150
Mahogany,	716,050	.25	159 92	114,512	....	716,050
Norway pine,	526,000	.19	29 20	15,357	....	526,000
Cottonwood,	330,000	.12	25 36	8,370	....	330,000
Western yellow pine,	320.000	.11	34 94	11,180	....	320,000
Cucumber,	267,300	.10	27 00	7,217	225,300	42,000

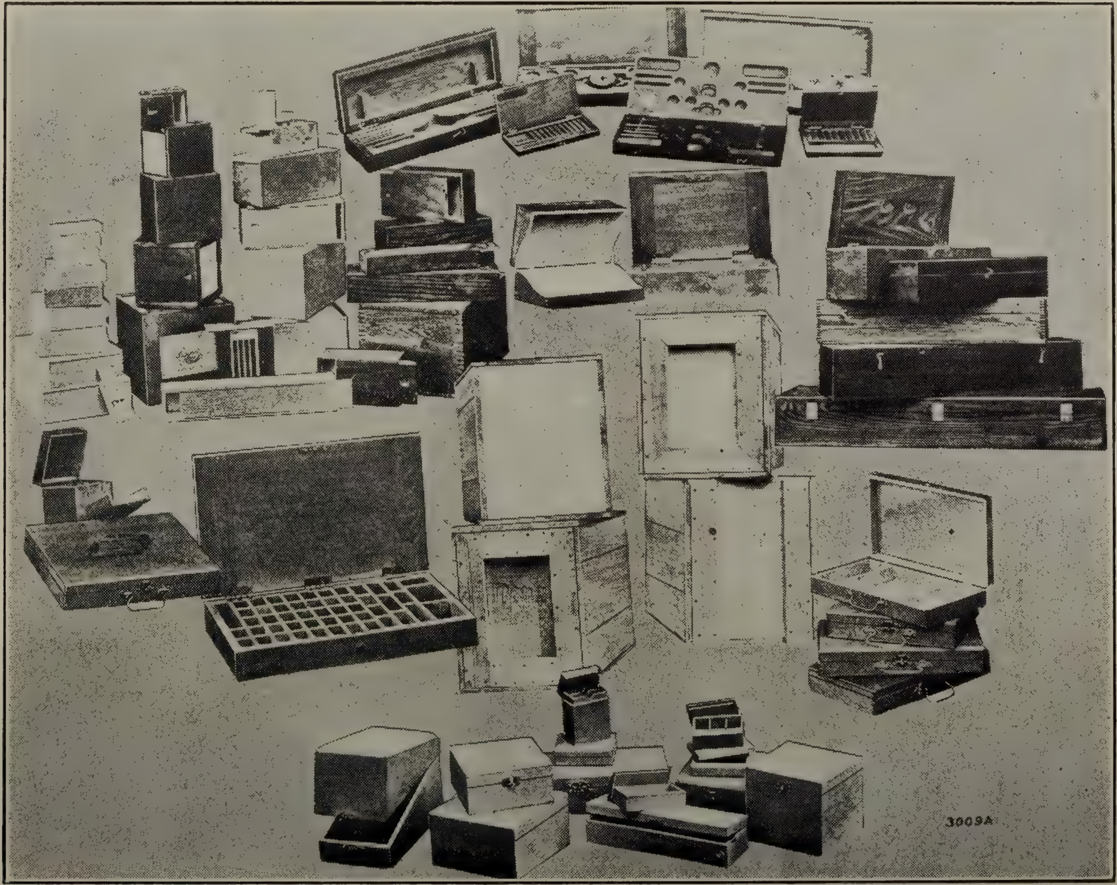

Fig. 2.—A collection of finished boxes, made in Pennsylvania.

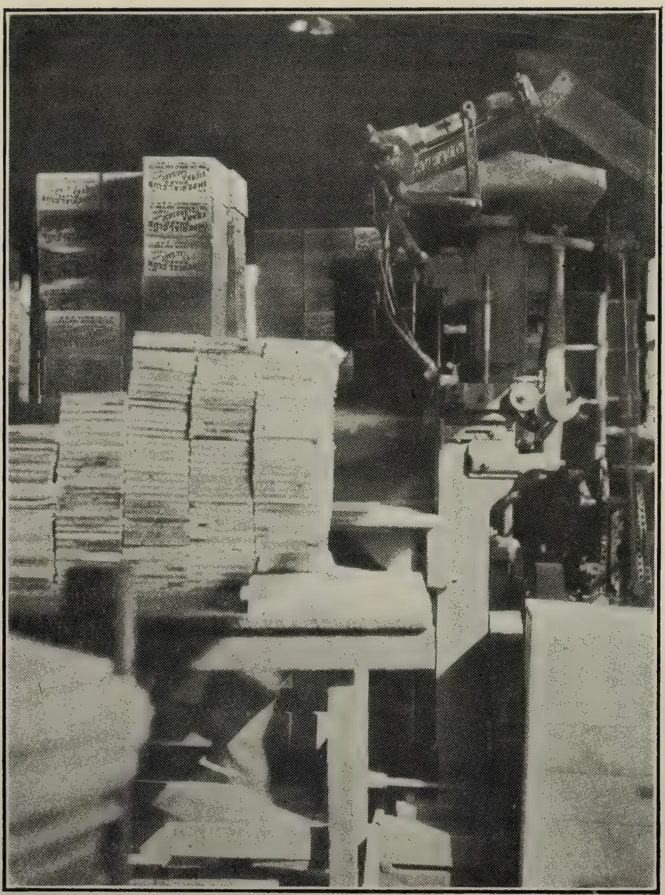

Fig. 3.—Box shooks and nailing machine in a Pennsylvania box factory.

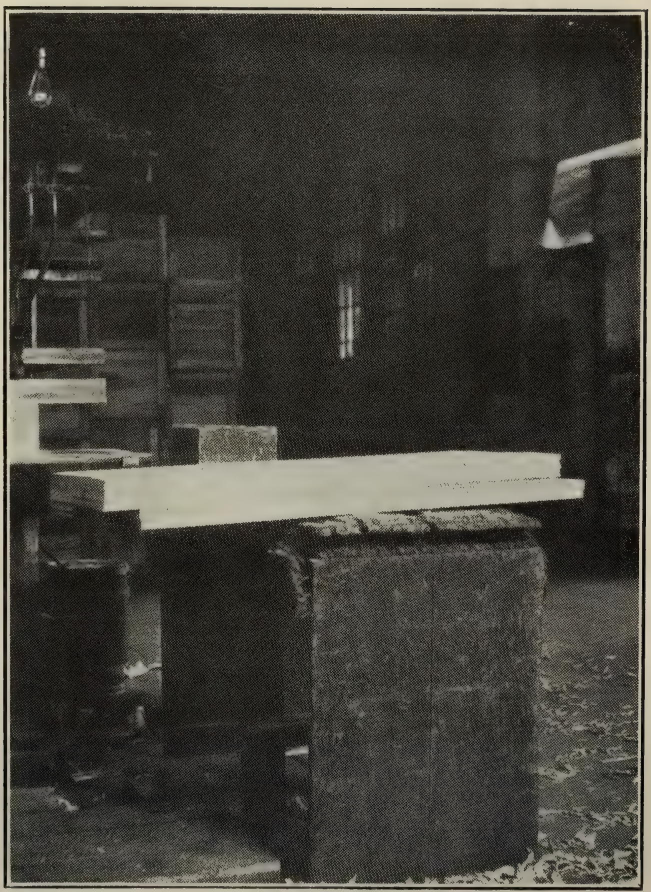

Fig. 4.—Interior of a small Philadelphia box factory. Boxes when nailed are used for city trade.

Table 47—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Red cedar,	213,000	.08	49 27	10,495	10,000	203,000
Redwood,	197,132	.07	49 19	9,697	....	197,132
Cherry (black),	177,385	.06	64 48	11,438	110,085	67,300
Cotton gum,	151,648	.05	26 55	4,027	....	151,648
Douglas fir,	108,500	.04	43 33	4,701	....	108,500
Hickory,	80,100	.03	27 03	2,165	70,100	10,000
Black walnut,	77,265	.03	111 31	8,600	52,365	24,900
Red and silver maple,	71,750	.03	26 19	1,879	31,750	40,000
Scrub pine,	70,000	.03	20 50	1,435	25,000	45,000
Western red cedar,	55,000	.02	39 09	2,150	....	55,000
Balsam fir,	40,000	.01	45 50	1,820	....	40,000
Yellow buckeye,	35,000	.01	20 71	725	19,000	16,000
Tamarack,	30,000	.01	23 00	690	....	30,000
Sycamore,	28,300	.01	45 72	1,294	17,000	11,300
Sitka spruce,	15,000	.01	35 40	531	....	15,000
Butternut,	9,600	*	30 21	290	6,600	3,000
White elm,	4,000	*	23 00	92	4,000	....
Southern white cedar,	1,000	*	120 00	120	....	1,000
Circassian walnut,	500	*	250 00	125	....	500
Total,	281,717,600	100.00	$33 46	$9,427,936	83,652,088	198,065,512

*Less than 1-100 of 1 per cent.

BOXES.

Next to building material, more wood goes for making boxes and crates in Pennsylvania than for any other use. Over six hundred factories reported the information collated in Table 48. Not more than half of these were regular box manufacturers, as is shown by the list of names in the appendix. There are included glass factories, steel mills, refractories, machinery manufacturers, makers of electrical apparatus, foundries, furniture makers, silk and textile mills, paper factories, large jobbing and department stores, etc., which maintain box departments for making packages and shipping containers to meet their own requirements. The uses of boxes are so numerous in Pennsylvania that it is not practical to attempt to mention or list them. Generally it can be said they are of two kinds, set-up boxes and box shooks. The former includes the nailed, the reinforced, the veneer, the locked corner, and dovetailed, or boxes that are sold ready to use. The nailed box is usually sold in the locality in which it is made. It is rarely shipped put together. The large number of this kind accounted for in Pennsylvania was principally in the large cities where there is an extensive demand or else near to factories and mills using the wooden packages. The reinforced box is a nailed box, the nailed joints and often the body of the box being reinforced with cleats, wire, or steel bands. These are used for shipping ponderous materials where the package is subjected to great strain. Of late this method has also become popular for containers for light materials, including large boxes for millinery, etc., when only very thin resawed material about three-eighths to one-fourth inch is used and the necessary strength supplied by the cleats. Reshippers belong to this class, most frequently reinforced with steel bands.

They are box crates for carrying back and forth bottled goods and are made of strong material. All that are used in Pennsylvania are not made in the State. Many are shipped in from Maryland, Delaware and Virginia.

The veneer box has recently made remarkable progress. The question of saving in weight and the revenue from the sale of second hand boxes, which lately is being given considerable attention by shippers, has helped the veneer package. The single ply box, wire bound, competes actively with the fiber shipping box but the progress these have made is not so surprising as that of the three ply veneer box. In these the sides, top, and bottom are panels built of three sheets of veneer with the grain transversing and well supported with cleats of thick material. The panels are not only strong and light in weight but the appearance of the single piece sides makes an attractive package. The glue pot enters as an important factor in their manufacture as a good glue joint is the most essential requirement, and, if assured, panel making is simple and makes both for economy and efficiency. Many more of these boxes are shipped into Pennsylvania knocked down than are made in the State. The panel makers are largely in the south where the stands of cheap veneer woods, principally the gums, are easily accessible.

White pine and basswood are the woods for dovetailed and locked corner boxes and large quantities are annually demanded for their making. These are small size containers but probably present the most attractive appearance of any form of wooden packages. They are used for articles of food, powdered substances, jewelry, etc., as the close joints make them more dust and moisture proof. The dovetailed box requires no gluing but the locked corner does. Both kinds are made in Pennsylvania, the latter in the largest quantities. Boxes with the bevel joint corner are not made any more in large quantities. Only a few manufacturers in Pennsylvania reported them.

Shooks are knocked down boxes sold conveniently bundled to facilitate their being assembled and nailed. Different from nailed boxes made and sold in the same region, shooks are manufactured close to the source of the raw material and sent over long distances to consuming centers. A large part of the boxes used in Pennsylvania, but not made there, are brought in in shook form. Shook making includes both shooks for boxes and knock-down crates. Rough lumber of any thickness or kind used to do for crating, and the lumber yard rather than the box factory was the source of the supply. Today the manufacturer shipping his wares in crates desires to express as much character in his package as do those using box containers. In consequence, the shook makers are called on for neat and attractively designed crates and like shooks they are sold with the several parts bundled together, due attention having been given to the size, kind, and thickness of the material in accordance with the weight and character of the goods to be shipped in them.

Another increasing use for crating is the growing tendency to crate articles of steel, iron, and other infrangible metals which heretofore were shipped unboxed. This more especially applies to Pennsylvania than any other state because of the number of industries manufacturing steel and iron products. Massive parts of machinery and electrical apparatus, sheet steel, engines and motors, parts of steel bridges, farm machinery, steam and hot water radiators, stoves and ranges, galvanized iron goods, steel frames for street cars, etc., are examples, and crating is intended more to prevent scarring the finish than to protect from breakage.

As Table 48 shows, the Pennsylvania box makers do not demand a few kinds of wood greatly in excess of others. Nor do they use State-grown woods in preference to lumber that comes from other timbered regions. There were 34 kinds of wood and the total of 11 were shipped in from other states. Of these the principal were several species of southern pine, and the gums that come chiefly from Virginia and the Carolinas. The total quantity is equivalent to 65 per cent. of the total box material used. White pine, chestnut, hemlock, yellow poplar, and beech were in quantity the principal Pennsylvania woods reported, and cherry, sycamore, and butternut the only kinds reported as entirely home grown. Considering the cut of hemlock in the State, the amount used for boxes and crates was disappointing. But in this particular, this report should prove most useful as with the names and addresses of the box makers and of those using lumber for crating the opportunity is given for increasing the home market for the low grades of lumber cut in the State.

Woods are listed in the table that are rarely used for packing boxes. Their appearance can be accounted for by the fact that they are for novelties which are more or less fancy boxes like sewing cases, for toilet articles, utility boxes, shoe polishing outfits, and those more or less ornamental used in stores for keeping cutlery, jewelry, drugs, etc.

Table 48.—Wood for Packing Boxes and Crates, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Shortleaf pine,	52,719,727	19.25	$18 00	$949,003	....	52,719,727
White pine,	51,583,373	18.83	21 03	1,084,714	19,390,373	32,193,000
Loblolly pine,	36,173,429	13.21	17 51	633,493	....	36,173,429
Yellow poplar,	18,576,293	6.78	17 44	323,971	4,330,100	14,246,193
Spruce,	14,648,870	5.35	17 42	255,211	975,350	13,673,520
Red gum,	12,806,084	4.68	16 68	213,611	....	12,806,084
Beech,	12,505,839	4.57	16 17	202,272	3,735,339	8,770,500
Chestnut,	11,977,692	4.37	16 04	192,165	6,275,328	5,702,364
Sugar maple,	11,647,000	4.25	16 43	191,340	3,282,500	8,364,500
Hemlock,	9,269,635	3.39	16 85	156,224	5,365,055	3,904,580
Red oak,	7,224,377	2.64	15 67	113,179	1,801,877	5,422,500
Pitch pine,	6,931,800	2.53	16 32	112,519	979,600	5,952,200
Birch,	5,999,000	2.19	16 76	100,556	2,488,500	3,510,500
Cottonwood,	4,680,000	1.71	24 60	115,135	40,000	4,640,000
Cotton gum,	3,458,722	1.26	14 13	48,873	....	3,458,722
Black gum,	3,089,800	1.13	15 36	47,463	....	3,089,800
Basswood,	2,936,400	1.07	16 93	49,708	1,324,400	1,612,000
Scrub pine,	2,251,400	.82	18 93	42,613	30,000	2,221,400
Cypress (bald),	1,719,250	.63	16 62	28,570	....	1,719,250
Silver and red maple,	1,267,000	.46	12 38	15,685	872,000	395,000
Western hemlock,	500,000	.18	20 00	10,000	....	500,000
Western yellow pine,	500,000	.18	20 00	10,000	....	500,000
White oak,	380,500	.14	23 84	9,070	148,000	232,500
Longleaf pine,	241,800	.09	22 04	5,330	....	241,800
White elm,	229,800	.08	23 50	5,400	82,300	147,500
Cork elm,	200,000	.07	25 00	5,000	50,000	150,000
Norway pine,	90,000	.03	20 00	1,800	....	90,000
Yellow buckeye,	80,500	.03	22 99	1,851	40,000	40,500
Cherry (black),	70,000	.03	19 00	1,330	70,000	....
Cucumber,	70,000	.03	17 00	1,190	....	70,000
Ash,	54,200	.02	23 51	1,274	53,500	700
Sycamore,	11,603	*	16 00	186	11,603	....
Butternut,	5,000	*	16 00	80	5,000	....
Red cedar,	5,000	*	35 00	175	2,500	2,500
Total,	273,904,094	100.00	$18 00	$4,928,991	51,353,325	222,550,769

*Less than 1-100 of 1 per cent.

CAR CONSTRUCTION.

Formerly all rolling stock except locomotive engines were built of wood but in recent years cars made entirely of metal or of wood with steel underframe equipment have begun to be substituted both for freight and passenger cars; and in the increasing extent in which they are meeting the demand each year, it is safe to predict that the amount of wood used in this industry will show a rapid decline. In this connection it is interesting to note that the last session of Congress in the interest of public safety had four bills pending requiring replacement of wooden passenger cars with steel equipment on all railroads. This movement is largely in accord with the present policy of the railroads as recent statistics show that approximately 90 per cent. of the passenger cars ordered for future delivery were specified to be of steel construction.

Notwithstanding the increasing substitution of metal for wood in car building, lumber in large amounts is still in demand. In Pennsylvania 228,000,000 feet or more reported for building or repair of cars for 1911 made that industry as to consumption third in the State. The building of cars of all kinds is represented by Table 49. Electric cars for city and interurban transportation is a division of the industry which requires special mention as more wood is used for passenger vehicle equipment in this line than in any other. Vast amounts of lumber are required each year for building mine cars. The number of mining establishments appearing in the directory appended to this report indicates to what extent work of this kind is done by wood-using departments maintained in connection with mining operations. Only one other state exceeds Pennsylvania in the quantity of wood used for car construction. The order of the principal states and the amount consumed is as follows:

Illinois,	407,000,000 feet
Pennsylvania,	228,000,000 feet
New York,	77,000,000 feet
Indiana,	59,000,000 feet
Ohio,	56,000,000 feet
Missouri,	51,000,000 feet
Virginia,	51,000,000 feet

Twenty-nine woods were used by the car builders in Pennsylvania and longleaf pine heads the list, contributing a little over one-third of the total. The superior tensile strength of this wood, its durable properties, and being easy to fit brings it first in demand by the car builder. If all the species of southern yellow pine were combined the amount would represent over one-half the car material reported and taking into consideration the needs of this industry in other states this wood is pre-eminently the principal wood for car construction. Lumber brought from the western states is not used so extensively in Pennsylvania as in other eastern states. Douglas fir and western white pine appear in the table but they were demanded in very limited quantities. The progress made of late in the use of steel underframes for cars of all kinds and especially gondolas and box cars has perhaps affected the use of oak more than any other wood as when these basal parts are made of wood, oak, preferably white and chestnut oak, are the kinds most extensively called for. The great strength of oak and its shock resisting capacity still brings it into wide use for car framing and such purposes, like draft timbers, tie beams, engine beams, platforms, truck parts, etc., and on account of its conspicuous figure, for interior finish of passenger and trolley cars. In this latter capacity it served with ash, birch, yellow poplar, cherry, mahogany, walnut, and red gum. Ash, poplar, and Douglas fir are the woods used in building the principal parts of locomotive cabs. The floors of the cabs are of sugar maple, the bumpers, pilots, and other parts of the engines are made of white oak.

The annual drain on the forests of the State by the car builders amounts to over 41,000,000 feet. This is less than one-fourth of the total but compared with requirements of other states where the industry is important the quantity of home-grown car material used in Pennsylvania is the largest. Some part of the supply of 20 of the 29 woods were cut in the State. Oak, white pine, hemlock, maple, ash, and beech in the order named as to quantity being the most prominent while the statistics for other woods are as follows:

Table 49.—Wood for Car Construction, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Longleaf pine,	76,932,160	33.69	$32 21	$2,477,985	....	76,932,160
White oak,	50,333,833	22.04	26 63	1,340,166	20,627,572	29,706,261
Shortleaf pine,	32,724,334	14.33	26 10	854,105	....	32,724,334
Red oak,	31,059,530	13.60	25 35	787,322	9,462,220	21,597,310
White pine,	12,829,420	5.62	31 38	402,637	4,041,869	8,787,551
Loblolly pine,	4,827,625	2.11	25 98	125,422	....	4,827,625
Ash,	4,396,915	1.92	56 70	249,311	933,908	3,463,007
Yellow poplar,	3,172,113	1.39	57 43	182,175	310,611	2,861,502
Hemlock,	2,006,075	.88	15 53	31,153	1,975,075	31,000
Sugar maple,	1,976,110	.87	18 14	35,856	1,344,660	631,450
Norway pine,	1,518,300	.66	28 97	43,985	25,000	1,493,300
Beech,	1,377,500	.60	17 12	23,583	847,500	530,000
Spruce,	1,367,636	.60	26 35	36,032	189,700	1,177,936
Hickory,	1,115,306	.49	24 50	27,325	343,697	771,609
Pitch pine,	458,600	.20	16 10	7,383	214,800	243,800
Cherry (black),	431,414	.19	60 59	26,140	216,951	214,463
Basswood,	366,010	.16	40 74	14,911	140,214	225,796
Cypress (bald),	352,800	.15	37 93	13,380	....	352,800
Birch,	312,845	.14	28 86	9,029	231,045	81,800
Mahogany,	230,718	.10	131 88	30,428	....	230,718
Chestnut,	113,250	.05	21 04	2,383	113,250	....
Redwood,	100,000	.04	36 00	3,600	....	100,000
Western white pine,	87,500	.04	54 99	4,812	....	87,500
Douglas fir,	70,238	.03	45 55	3,199	....	70,238
Scrub pine,	64,695	.03	23 32	1,509	50,500	14,195
White elm,	63,343	.03	49 43	3,131	....	63,343
Black walnut,	56,890	.02	101 13	5,753	980	55,910
Red gum,	35,140	.02	27 02	950	....	35,140
Black gum,	600	*	58 00	35	....	600
Total,	228,380,900	100.00	$29 53	$6,743,700	41,069,552	187,311,348

*Less than 1-100 of 1 per cent.

FURNITURE.

Pennsylvania in the quantity of wood consumed does not compare with a number of other states in the manufacture of furniture, but this industry is one of the oldest in the State and includes in its production the highest grades of furniture and therefore is of considerable economic importance. Furntiure can be divided into two general classes: (1) Articles of utility like refrigerators, kitchen cabinets, provision safes, cupboards, etc. These are not a part of the industry here considered, but like chairs have been presented under a separate classification. (2) Commodities where the appearance is as important as durability. In a large number of instances a piece of furniture is not only pleasing to the eye in its ornamental appointments but from a practical point of view is made of the most suitable material for the purpose. Wood, on account of its natural, attractive grain will be the regular furniture material as long as hardwood timber lasts, and at present there is almost as wide a choice of material in this line as there is lumber available for more common uses. Of the 35 woods listed in Table 50 some part of 22 are wholly or in part decorative woods. Painted or enameled furniture is again coming into favor and in Pennsylvania a considerable quantity of the softer hardwoods was reported for this line of work.

Among the products included in this industry are bedroom furniture, chiffoniers and bureaus, dining tables and buffets, parlor outfits including upholstered furniture, hall appointments, desks, china closets, and book cases. Many of the woods reported went only into parts of furniture not visible, such as coring, frames, brackets, reinforcements, drawer slides, bottoms, and table slides.

Of the exterior woods for the cheaper grades of furniture, solid woods with pronounced grain are most available like red and white oak, ash, chestnut, red gum, butternut, etc. The more expensive work is usually backed with a fairly strong wood adaptable to glue, stable when in place and finished with veneer. This method produces the most pleasing and attractive effects and a permanence rarely to be achieved by the use of solid woods. Indeed it is a rare occasion when the expensive woods such as mahogany, Circassian walnut, rosewood, bird's eye maple, black walnut, etc., are used in solid pieces. Veneer is purchased from the veneer mills according to surface measure, the sheets ranging from 1/24 to ⅛ inch in thickness. The foreign woods are imported in the form of logs and flitches and are cut to veneer by mills in this country. Cores or backing for veneer are made of solid and built-up lumber purchased ready-made with several layers of cheap domestic woods glued with grains transversing. This material has the advantage of being freer from warping tendencies than lumber, besides being lighter, having exceptional strength, and not liable to split. A number of the most particular uses of the several woods shown in the table for furniture have been arranged in the following order:

BEDROOM FURNITURE.

Rails.

White oak.
Red oak.
Circassian walnut.
Mahogany.
Sweet birch.
Sugar maple.
Black walnut.
Sycamore.
Yellow poplar.
Cherry.
Red gum.

Panels.

White oak.
Sweet birch.
Black walnut.
Red oak.
Sycamore.
Circassian walnut.
Sugar maple.
Mahogany.
Yellow poplar.
Cherry.
Red gum.

Posts.

Black walnut.
Red oak.
Sycamore.
Mahogany.
Sugar maple.
Sweet birch.
Red gum.
White oak.
Circassian walnut.
Cherry.

Drawer fronts.

White oak.
Sweet birch.
Black walnut.
Sycamore.
Circassian walnut.
Sugar maple.
Red oak.
Mahogany.
Yellow poplar.
Cherry.
Red gum.

BED ROOM FURNITURE—Concluded.

Drawer sides and ends.
Yellow poplar.
Chestnut.
Beech.
Cherry.
White pine.
Red gum.
Sweet birch.
Basswood.

Drawer bottoms.
Yellow poplar.
Sycamore.
Basswood.
Cotton gum.
Beech.
Red gum.
Cottonwood.

Drawer slides.
Sugar maple.
Hickory.

Mirror frames.
Sycamore.
Sugar maple.
White oak.
Mahogany.
Black walnut.
Circassian walnut.
Yellow poplar.
Cherry.
Red gum.

Backing.
Yellow poplar.
Chestnut.
White pine.
Red gum.
Soft maple.

Bed slats.
Loblolly pine.
Sweet birch.
Sugar maple.
White ash.
Shortleaf pine.

UPHOLSTERED FURNITURE.

Frames (hidden work).
Basswood.
Soft maple.
Longleaf pine.
White oak.
Chestnut.
Shortleaf pine.

Frames (exterior).
Mahogany.
Sweet birch.
White oak.
Red oak.
Black walnut.
Red gum.

Special furniture.
Eucalyptus.
Rosewood.
Red cedar.
Spanish cedar.

BUFFETS, CHINA CLOSETS, CRYSTAL CABINETS, AND SIDEBOARDS.

Tops.
Black walnut.
White oak.
Red oak.
Mahogany.
Sweet birch.

Rails.
White oak.
Red oak.
Black walnut.
Mahogany.
Sweet birch.

Backing.
Chestnut.
Basswood.
Yellow poplar.
Red gum.
Soft maple.
White pine.

Posts.
White oak.
Red oak.
Mahogany.
Sweet birch.
Black walnut.

Doors and door frames.
Black walnut.
Mahogany.
White oak.
Red oak.
Sweet birch.

Bottoms.
Basswood.
White oak.
Red oak.
Sugar maple.

Inlaid work.
Mountain laurel.
Sumach.

Shelves.
Sweet birch.
White pine.
Yellow poplar.

BOOKCASES, DESKS AND MAGAZINE RACKS.

Tops.
- Black walnut.
- White oak.
- Red oak.
- Mahogany.
- Sweet birch.
- Red gum.
- Circassian walnut.
- Yellow poplar.

Panels.
- Red gum.
- Red oak.
- Mahogany.
- Circassian walnut.
- Sweet birch.
- White oak.
- Black walnut.

Posts.
- Mahogany.
- Red oak.
- White oak.
- Black walnut.
- Red gum.
- Sweet birch.
- Circassian walnut.

Doors and drop lids.
- Sweet birch.
- Circassian walnut.
- Mahogany.
- Black walnut.
- White oak.
- Red oak.

Backing.
- Chestnut.
- Basswood.
- Yellow poplar.
- Red gum.
- Soft maple.
- White pine.

Bottoms.
- Basswood.
- White oak.
- Red oak.
- Sugar maple.
- Yellow poplar.

Shelves.
- Sweet birch.
- White pine.
- Basswood.
- Yellow poplar.

LIBRARY AND DINING ROOM TABLES.

Tops.
- White oak.
- Chestnut.
- Sweet birch.
- Red gum.
- Butternut.

Legs.
- White oak.
- Sweet birch.
- Red gum.
- Mexican mahogany.
- Sugar maple.

Pedestals.
- White oak.
- Red oak.
- Mahogany.
- Sweet birch.
- Yellow poplar.

Slides.
- Sugar maple.
- Beech.

Table leaves.
- White oak.
- Red oak.
- Mahogany.
- Sweet birch.
- Butternut.

Rails.
- White oak.
- Red oak.
- Mahogany.
- Sweet birch.
- Red gum.
- Butternut.

Table 50.—Wood for Furniture, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Red oak,	16,091,700	27.28	$35 73	$574,997	2,443,600	13,648,100
Chestnut,	11,556,850	19.59	19 52	225,599	5,586,300	5,970,550
White oak,	10,133,050	17.18	47 30	479,283	2,771,050	7,362,000
Sugar maple,	4,743,900	8.04	26 72	126,632	3,640,100	1,103,800
Basswood,	3,945,400	6.69	35 13	138,592	1,105,400	2,840,000
Yellow poplar,	2,892,000	4.90	36 86	106,593	346,700	2,545,300
Red gum,	2,297,000	3.89	34 25	78,666	....	2,297,000
Red and silver maple,	1,478,500	2.51	25 49	37,682	730,500	748,000
Beech	1,453,000	2.46	16 23	23,582	1,397,000	56,000
Mahogany,	1,145,650	1.94	116 42	133,378	....	1,145,650
Birch,	1,138,270	1.93	29 10	33,126	525,900	612,370
Cottonwood,	380,000	.64	34 87	13,250	....	380,000
White pine,	298,700	.51	44 32	13,239	281,500	17,200
Cotton gum,	236,500	.40	33 54	7,933	....	236,500
Red cedar,	178,100	.30	60 81	10,830	....	178,100
Ash,	175,500	.30	28 43	4,989	82,500	93,000
Shortleaf pine,	141,000	.24	23 92	3,374	....	141,000
Longleaf pine,	138,500	.23	31 83	4,408	....	138,500
Black walnut,	130,100	.22	95 04	12,365	21,000	109,100
Cherry (black),	113,900	.19	34 74	3,957	105,600	8,300
Circassian walnut,	92,840	.16	364 08	33,801	....	92,840
Cypress (bald),	80,500	.14	43 19	3,477	....	80,500
Sycamore,	66,170	.11	43 89	2,904	3,000	63,170
Loblolly pine,	58,006	.10	22 79	1,322	....	58,000
Western yellow pine,	10,000	.02	45 00	450	....	10,000
Rosewood,	5,180	.01	500 00	2,590	....	5,180
Eucalyptus,	5,000	.01	260 00	1,300	....	5,000
Butternut,	3,500	.01	26 61	93	3,500	....
Spanish cedar,	2,500	*	80 00	200	....	2,500
Southern white cedar,	1,300	*	120 00	156	....	1,300
Mountain laurel,	1,000	*	40 00	40	1,000	....
Hickory,	750	*	81 33	61	250	500
Sumach,	500	*	80 00	40	500	....
Teak,	190	*	200 00	38	....	190
Satinwood,	120	*	200 00	24	....	120
Total,	58,995,170	100.00	$35 24	$2,078,971	19,045,400	39,949,770

*Less than 1-100 of 1 per cent.

CHAIRS.

Pennsylvania is one of the three leading states in the manufacture of chairs. Over 30,000,000 feet of wood is annually required for their manufacture and of this amount considerably over half is furnished by the forests of the State. The order of the first six states in quantity of wood consumed for chairs is as follows: Wisconsin, North Carolina, Pennsylvania, Massachusetts, New York, and Vermont. It may occur to some that chairs should be grouped with furniture but in Pennsylvania as in other states their manufacture is essentially a distinct industry, generally the form of the raw material is different, the processes of manufacture are in nowise similar, and the products are marketed separately.

Dimension stock is the form of raw material that is utilized in the chair industry perhaps to a greater extent than any other. Sawmills cutting hardwoods and factories using them, principally beech, birch, and maple, often operate as a side line the bolting of low grades and waste into these squares.

Many go as far as to turn the dimensions on lathes after bolting and sell them in that form to chair factories ready to assemble. In the case of the lumbermen, frequently small crooked logs, tops, wind shakes, cut offs, which can be worked for sale in no other way, are thus disposed of. The chair makers, therefore, play an important part not only in lending to the industrial development of the State but also to the movement of conservation in their efforts to encourage utilization or waste. One manufacturer purchases hardwood slabs and edgings from a nearby sawmill and transports this material to his factory for turning handles and chair stock. Another purchases part of the refuse of hardwood stave manufacturers, selects the core and other large pieces, and converts them into chair dowels and rungs.

Chair dimensions include stock of various sizes and kinds for the large number of different designs the chair manufacturers turn out. Table 51 shows the number and kinds of woods that were used in Pennsylvania. Not all chair material is in dimensions by any means. Because seats and backs are altogether cut out of plank ranging from 1½ inches to 2½ inches thick and because the factories are not able to secure enough dimension and turned material to meet their requirements, they are compelled to buy large quantities of plank and rip them up into squares for posts, pillars, spindles, rounds, dowels, etc. The chair stock is always seasoned before used, but those producing squares and turned stock often use unseasoned wood allowing it to air-dry under cover after being manufactured. To prevent loss caution is taken to make allowance for shrinkage and the producer is particular to see to it that the chair stock is straight grained, practically free from defects, and accurately manufactured to conform to specifications.

Perhaps the largest part of the wood used in Pennsylvania is required for turned chairs but quantities are also demanded for straight line designs where the parts are cut considerably wider than they are thick. The demand for these in late years has been on the increase and has led up to the mission patterns in which the stock is still wider and heavier.

Unlike the parts of turned chairs, the manufacturers do not buy their material for the square designs to any extent in the form of dimensions but usually cut them from plank. This is unfortunate because the sawmills have a considerable amount of waste which it is practical to cut into dimension stuff suitable for this line of manufacture. Millmen should note this opportunity and consider negotiations for furnishing this material from waste; and, on the other hand, the economy to the manufacturers should induce the latter to consider the advisability of making overtures to the millmen. Oak, both red and white, ash, and chestnut are the principal woods for chairs of square and mission designs. Other woods like red gum, birch, and elm are used and a figure is stamped on them resembling oak, mahogany, and other woods. That the better grades of chairs are made in Pennsylvania as well as cheaper ones, is evident by the quantity of mahogany brought into the State each year to meet the demand. Birch is most used for imitating mahogany. Woods used for various parts of chairs are as follows:

CHAIRS.

Arms.
- Mahogany.
- Red gum.
- Soft maple.
- White oak.

Bent arms.
- Elm.

Backs.
- Birch.
- Elm.
- Mahogany.
- Red gum.
- Red oak.
- Soft maple.
- White oak.
- Yellow poplar.

CHAIRS—Continued.

Camp chairs and stools.
Beech.
Birch.
Sugar maple.

Chair frames, upholstered.
Chestnut.
Red oak.
Soft maple
Sugar maple.
White oak.

Dowels.
Beech.
Birch.
Soft maple.
Sugar maple.

Fancy chairs.
Mahogany.
Sycamore.
Walnut, black.

Pillars.
Beech.
Birch.
Sugar maple.
White oak.

Posts.
Beech.
Birch.
Mahogany.
Sugar maple.
Red oak.
White ash.
White oak.

Rockers.
Elm.
Sugar maple.
White ash.
White oak.

Rolling chair parts.
Hickory.
Red oak.
Sugar maple.
White oak.

Rounds.
Beech.
Birch.
Hickory.
White oak.
White ash.

Seat frames.
Red oak.

Seats.
Elm.
Mahogany.
Red gum.
Red oak.
Soft maple.
White oak.
Yellow poplar.

Split seats.
Hickory.

Split backs.
Hickory.

Legs.
Beech.
Birch.
Mahogany.
Sugar maple.
Red oak.
White oak.

Mission chairs.
Red oak.
White oak.

Panels.
Mahogany.

Piano stools and benches.
Birch.
Mahogany.
Sugar maple.
White oak.

Spindles.
Beech.
Birch.
Sugar maple.
White ash.

Stretchers.
Beech.
Birch.
Sugar maple.
White ash.

Built-up chair stock, veneer.
Basswood.
Birch.
Chestnut.
Mahogany.
Red gum.
Red oak.
Soft maple.
Sugar maple.
Walnut, Circassian.
White ash.
White oak.

Table 51.—Wood for Chairs, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Beech,	8,420,000	25.43	$17 21	$144,945	7,295,000	1,125,000
White elm,	6,213,500	18.76	26 76	166,243	62,000	6,151,500
Sugar maple,	5,348,100	16.15	18 54	99,180	4,746,500	601,600
Red gum,	4,326,000	13.06	25 97	112,328	....	4,326,000
Red oak,	2,997,200	9.05	33 96	101,785	1,066,500	1,930,700
White oak,	2,228,800	6.73	42 10	93,837	281,800	1,947,000
Birch,	992,400	3.00	30 05	29,824	583,500	408,900
Red and silver maple,	918,500	2.77	28 17	25,876	155,000	763,500
Sycamore,	500,000	1.51	25 00	12,500	....	500,000
Chestnut,	480,000	1.45	17 71	8,499	95,000	385,000
Mahogany,	461,800	1.39	110 11	50,848	....	461,800
Ash,	104,300	.32	24 54	2,559	37,300	67,000
Black walnut,	50,000	.15	66 08	3,304	44,000	6,000
Basswood,	33,000	.01	22 12	730	25,000	8,000
Yellow poplar,	24,600	.07	38 05	936	....	24,600
Hickory,	15,000	.05	17 20	258	75,000	....
Circassian walnut,	3,800	.01	200 00	760	....	3,800
Total,	33,117,000	100.00	$25 80	$854,412	14,406,600	18,710,400

VEHICLES AND VEHICLE PARTS.

The statistics presented in Table 52 represent the wood used both for motor and horse drawn vehicles. Though there is considerable material used in the manufacture of motor cars including both pleasure cars and commercial trucks, fully 90 per cent. of the material reported went into the latter. The rapid growth of the automobile industry has greatly increased the demand for the vehicle woods, but, according to reports, has not made a corresponding reduction in the demand for horse drawn vehicles. In fact a number of Pennsylvania manufacturers, especially wagon makers, remarked upon the increased production of horse drawn vehicles in the last five years; and those that formerly specialized in building buggies and wagons and now are engaged in making autos have in most cases not relinquished the manufacture of the horse vehicle but have increased their facilities and manufacture both kinds.

Often carriage manufacturers are practically nothing more than assemblers of parts. They buy the wheels and other portions of the running gears and the bodies and tops already manufactured and enter into production only as finishers. In the same way wheelwrights and repair shops that are distributed in nearly every village and town throughout Pennsylvania purchase much of their material like spokes, rims, hubs, hounds, and felloes ready to use. Information was not solicited from these classes of establishments as the scope of the investigation excludes them.

The number of manufacturers making vehicle parts is large in Pennsylvania and the quantity of wood they consumed represents the largest proportion of that shown in the table. Most of this class report making only one commodity as hubs, spokes, rims, poles or shafts. A few, however, specialize in manufacturing two, but in no instance were there reported as many as three.

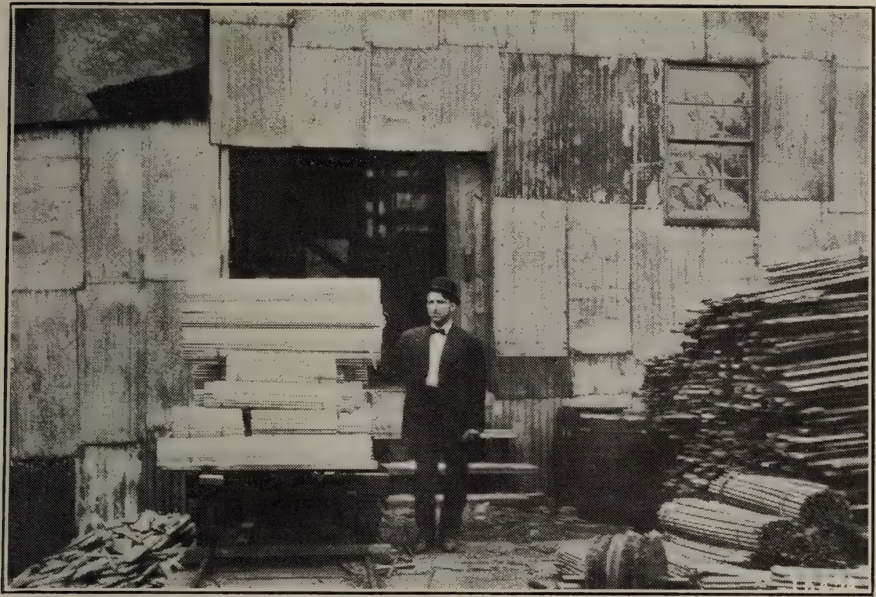

Fig. 5.—Utilization of mill waste. Rough squares are bolted from slabs and edgings, and turned into chair stock.

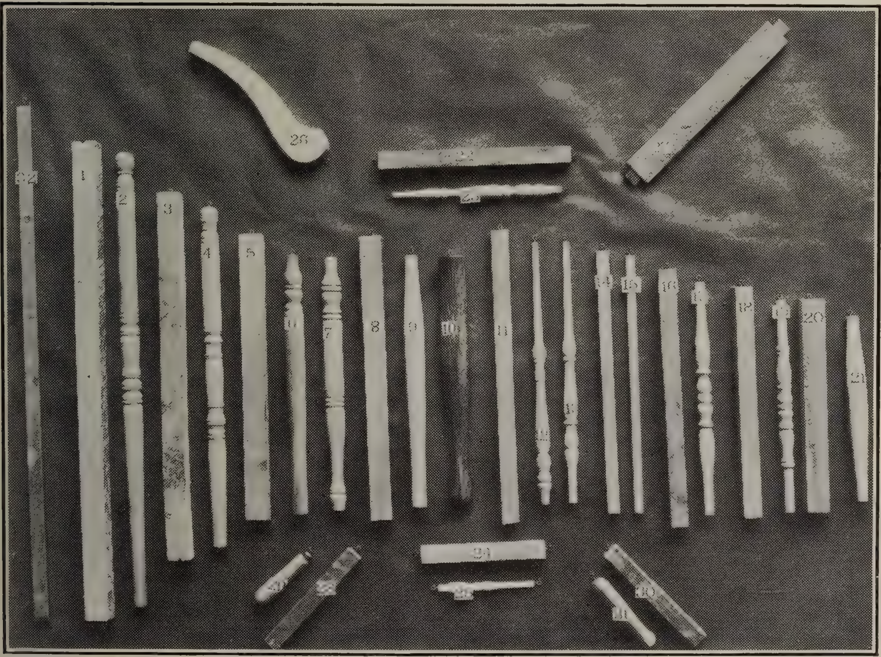

Fig. 6.—Chair parts and the squares or dimension stock from which they are made.

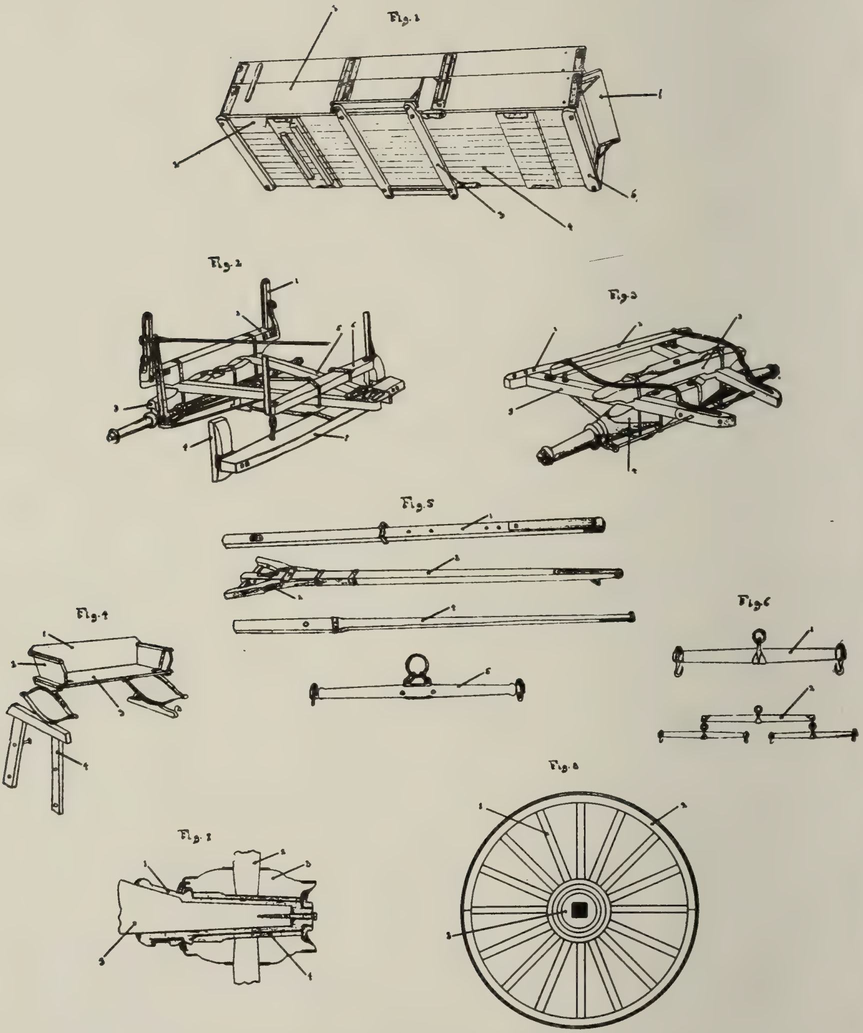

Fig. 7. Parts of a farm wagon, and the woods used.

DESCRIPTION OF FIGURE 7.

FARM WAGON.

Fig. 1. Wagon Body.

1. Wagon box: Longleaf Pine, Yellow Poplar, Cottonwood, Red Gum, White Pine.
2. Sills: White Oak, Red Oak, Sugar Maple, White Ash.
3. Braces: Red Oak, White Oak, Longleaf Pine, Shortleaf Pine, White Ash.
4. Wagon bed: Longleaf Pine, Loblolly Pine, White Oak, Red Oak, Pitch Pine, Spruce, Sugar Maple, White Ash.
5. Cross sill: White Oak, Red Oak, Sugar Maple, White Ash.
6. Foot rest: Longleaf Pine, Shortleaf Pine Loblolly Pine, White Oak, Red Oak.

Fig. 2. Rear Gear.

1. Stakes,
2. Bolsters.
3. Axle bed or axle cap,
4. Brake block,
5. Rear hounds,
6. Hound bar,
7. Brake bar,

White Oak.
Red Oak.
Sugar Maple.
Black Birch.
Hickory.
Hornbeam.
White Ash.

Fig. 3. Front Gear.

1. Yoke,
2. Hound bar,
3. Bolster,
4. Axle,
5. Front hounds,

White Oak.
Red Oak.
Sugar Maple.
Black Birch.
Hickory.
Hornbeam.
White Ash.

Fig. 4. Seat.

1. Back board,
2. Side boards,
3. Bottom boards,

White Oak.
Red Oak.
White Pine.
Yellow Pine.
Shortleaf Pine.

4. Riser: White Oak, Red Oak, White Ash, Sugar Maple.

Fig. 5.

1. Reach: White Oak, Red Oak, White Ash, Hickory.
2. Tongue hounds: Hickory, White Oak, White Ash.
3. Drop tongue,
4. Coach tongue,

White Oak.
White Ash.
Hickory.
Longleaf Pine.

5. Neck Yoke: White Oak, White Ash, Red Oak, Hornbeam, Hickory.

Fig. 6.

1. Singletree,
2. Doubletree,

White Oak.
Red Oak.
White Ash.
Hornbeam.
Hickory.

Fig 7. Axle and Hub.

1. Skein.
2. Spoke.
3. Hub.
4. Hub boxing.
5. Axle.

Fig. 8. Wheel.

1. Spoke: White Ash, White Oak, Red Oak, Hickory.
2. Felloe or rim: White Oak, Red Oak, White Ash.
3. Hub: White Oak, Red Oak, White Elm, Rock Elm, Locust, Black Gum, Sugar Maple, Osage Orange.

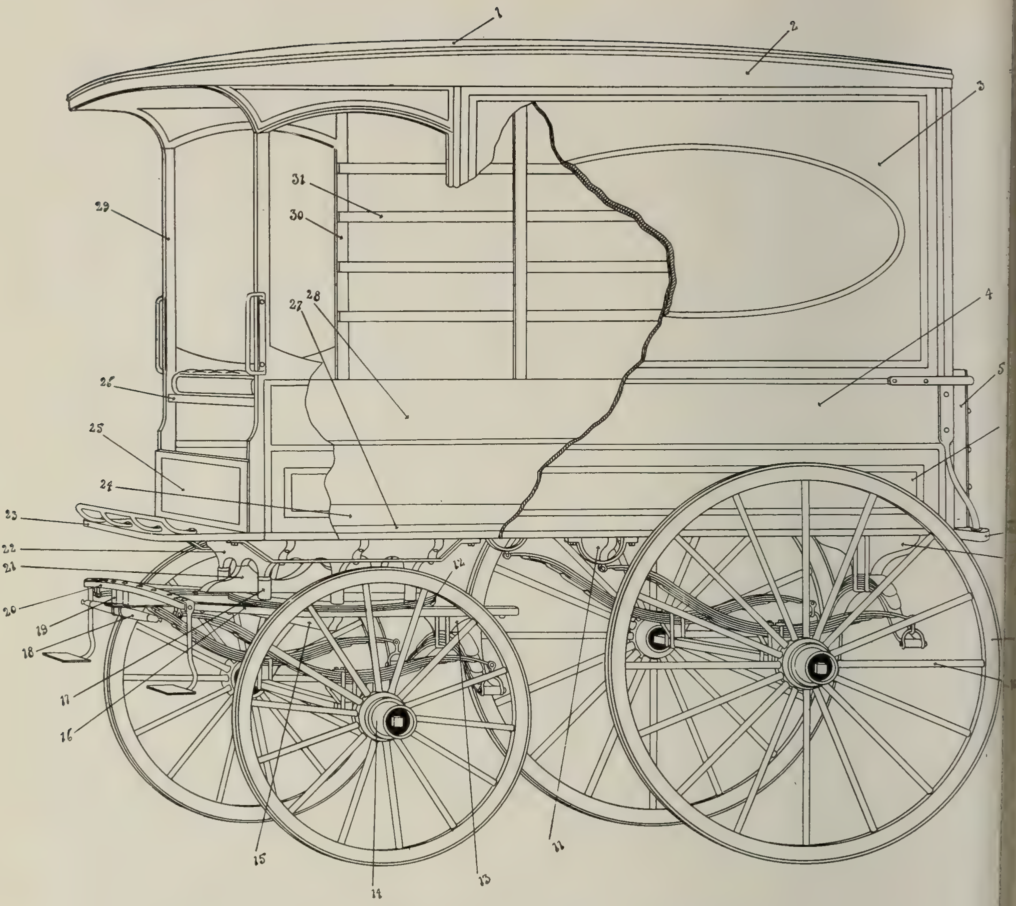

Fig. 8. Showing parts of delivery wagon, and woods used.

PLATFORM DELIVERY WAGON.

1. Top strips or slats: White Ash, Basswood, White Pine, Yellow Poplar, Sweet Birch.
2. Top rail: White Ash, White Oak.
3. Upper panel: Yellow Poplar.
4. Belt or belt panel: White Ash, White Oak.
5. Drop gate: White Ash, White Oak, Red Oak.
6. Lower panel or lower side board: White Oak, White Ash.
7. Stay bar or rear end crossbar: White Oak, Red Oak, White Ash.
8. Hind spring bar or rear spring crossbar: Hickory, White Ash.
9. Felloe or rim: Hickory, White Ash.
10. Spoke: Hickory, White Ash.
11. Shackle bar or front spring crossbar: Hickory, White Ash.
12. Fifth wheel circles: Hickory, White Ash.
13. Spring yoke or spring head block: Hickory, White Ash.
14. Hub: Black Gum, Rock Elm, Black Locust.
15. Lower head block: Hickory, White Ash.
16. Side futchel: Hickory, White Ash.
17. Fifth wheel spools: Hickory, White Ash.
18. Singletree:Hickory, White Ash.
19. Hounds or pole futchels: Hickory, White Ash.
20. Splinter or drawbar: Hickory, White Ash.
21. Upper head block or fifth wheel futchel: Hickory, White Ash.
22. Fifth wheel bars or transom bars: Hickory, White Ash.
23. Footboard or heel board: White Oak, White Ash.
24. Wagon bed: White Pine, Longleaf Pine, White Ash, Yellow Poplar, White Oak.
25. Front panel or cross board: Yellow Poplar, White Oak, Red Oak, White Ash.
26. Seat board: White Pine, White Ash, Longleaf Pine, White Oak.
27. Sill: White Oak, White Ash.
28. Lining: Yellow Poplar, White Pine, Longleaf Pine, Red Oak.
29. Corner posts or pillars: White Oak, White Ash.
30. Side pillars: White Oak, White Ash.
31. Side slats or rails: White Oak, White Ash.
32. Rear end posts: White Oak, White Ash.

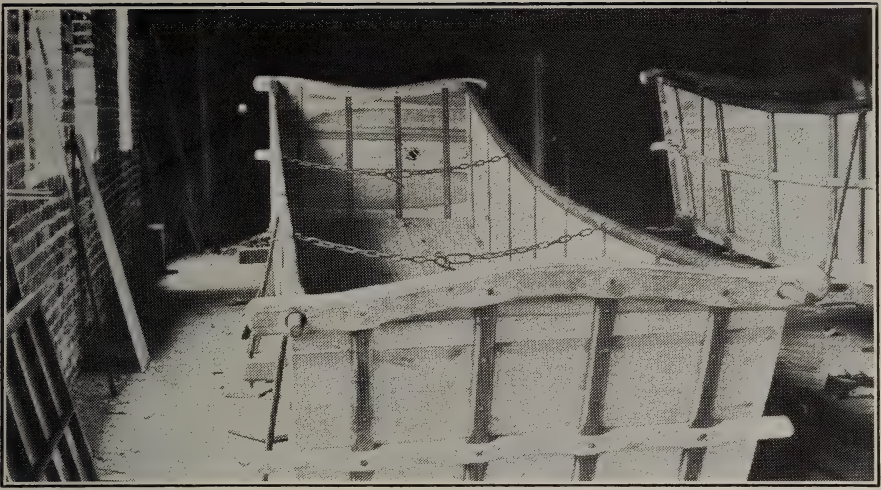

Fig. 9.—Body of an old-time Conestoga wagon. This style of wagon is still being manufactured in Pennsylvania.

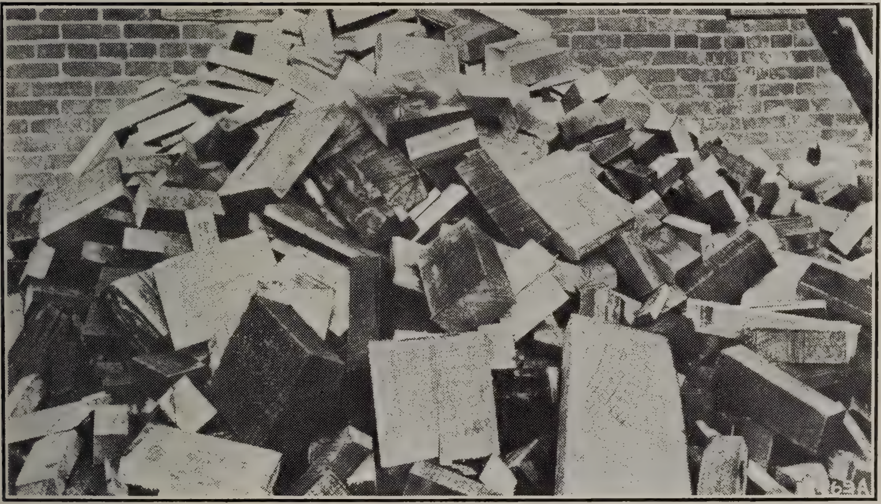

Fig. 10.—Hickory, oak and pine waste of a large Pennsylvania wagon manufacturer being sold for fuel. Much of this is suitable for small commodities made from this wood.

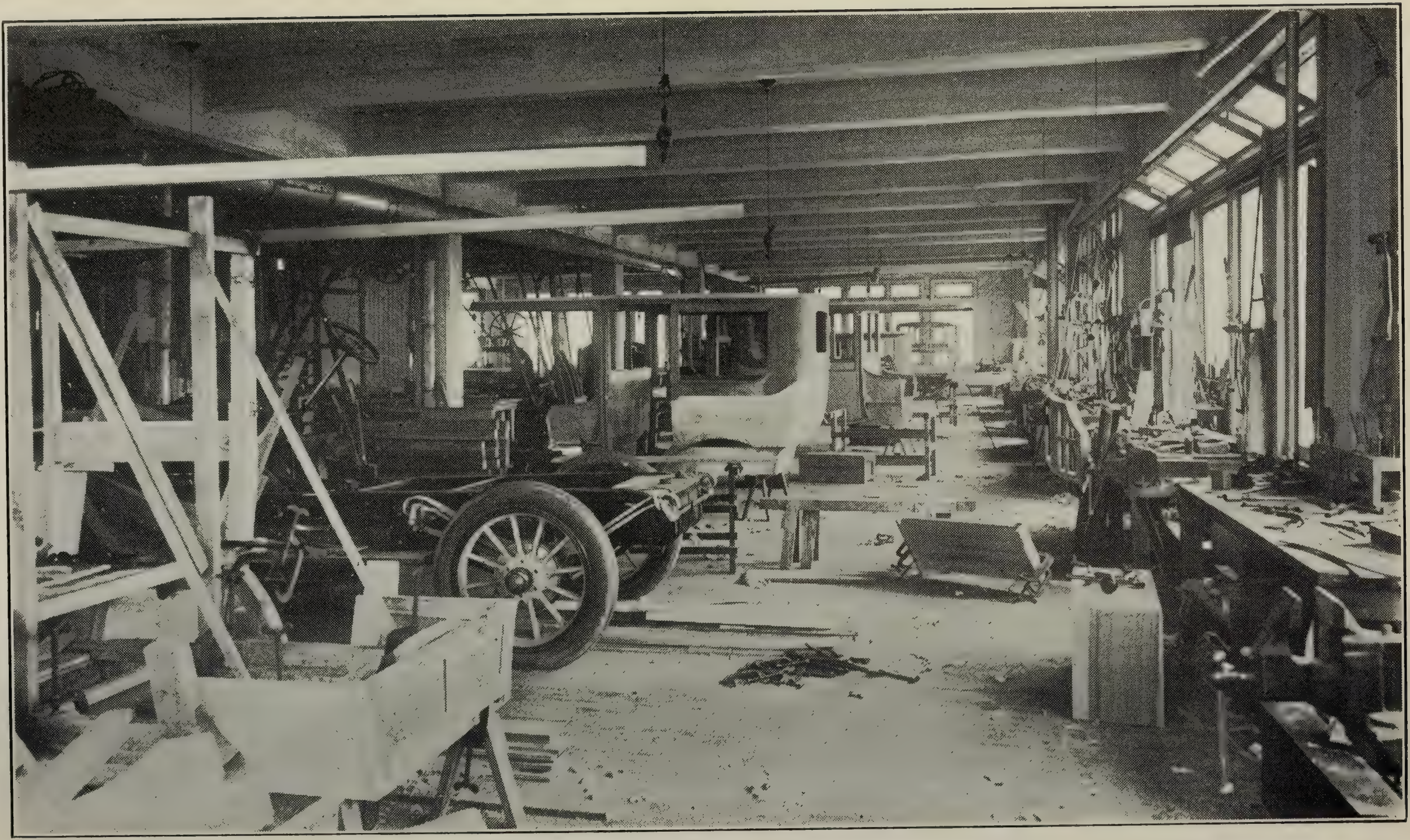

Fig. 11.—Manufacture of limousine bodies. Panel work of yellow poplar.

Thirty-two kinds of wood are used by the vehicle industry. That so many kinds are required is surprising, but this can probably be accounted for by the search being made for substitutes which has brought species heretofore little used into this industry for experimentation. For instance, elm was formerly the chief hub wood, but now birch has proved practical and large quantities are consumed by the hub makers. Yellow locust and black gum are also extensively used. Hickory was the principal spoke wood but now vast amounts of white and red oak are demanded; while yellow poplar does better than any other wood for bodies, large quantities of cottonwood and red gum are taking its place and some manufacturers prefer these because they do not split so easily and are susceptible of taking a higher polish. White ash is chiefly used at the present time for vehicle bows but it is not so well adapted to this use as hickory, white oak, or cork elm.

Hickory is the premier wood in vehicle making and white oak the next. The use of both of these is confined mainly to the production of gear parts. In the manufacture of heavy wagons, which is one of the most important divisions of this industry in Pennsylvania, white oak and red oak, the latter to a much less extent, are in the greatest demand. Yellow poplar, which comes third in the list, indicates the high grades of vehicle made in the State, as only the high priced carriages, delivery wagons, and automobiles can afford this wood on account of its cost. In the manufacture of automobile bodies and to a small extent for horse drawn vehicles metal has proved a formidable competitor of wood, but the fact that it is used for cheaper grades indicates that the use of wood gives better results. Next to yellow poplar, ash entered into body construction more than any other wood and in some states in which studies similar to this have been made the quantity used in this line exceeds that of yellow poplar. In Pennsylvania ash stands fourth. All of the rich cabinet woods reported were employed by the automobile body makers.

Table 52.—Wood for Vehicles and Vehicle Parts, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Hickory,	10,819,552	34.02	$48 51	$524,895	3,642,252	7,177,300
White oak,	10,819,552	34.02	$48 51	$524,895	4,378,300	2,500.667
Yellow poplar,	3,764,335	11.84	50.49	190,055	755,285	3,009,050
Ash	3,590,472	11.29	44 16	158,564	2,096,204	1,494,268
Birch,	1,514,500	4.76	48 11	72,864	455,000	1,059,500
Red oak,	994,900	3.13	28 43	28,285	589,800	405,100
Sugar maple,	625,800	1.97	28 67	17,940	314,200	311,600
Beech,	587,883	1.85	21 97	12,916	537,883	50,000
Longleaf pine,	576,550	1.81	34 33	19,791	....	576,550
Basswood,	477,850	1.50	30 10	14,384	258,500	219,350
Shortleaf pine,	467,200	1.47	26 67	12,461	....	467,200
Cork elm,	390,900	1.23	36 30	14,190	25,300	365,600
Red gum,	315,500	.99	32 37	10,212	500	315,000
Black gum,	181,800	.57	37 57	6,831	31,500	150,300
White pine,	140,550	.44	34 62	4,866	118,050	22,500

Table 52—Continued.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Hornbeam,	100,000	.32	30 00	3,000	50,000	50,000
White elm,	93,500	.29	34 31	3,208	70,500	23,000
Cottonwood,	64,000	.20	34 38	2,200	24,000	40,000
Pitch pine,	55,200	.17	22 77	1,257	55,200	....
Silver maple,	47,000	.15	26 13	1,228	47,000	....
Loblolly pine,	41,900	.13	28 07	1,176	....	41,900
Chestnut,	30,200	.10	19 77	597	18,200	12,000
Mahogany,	14,900	.05	159 13	2,371	....	14,900
Locust (black),	11,000	.04	18 73	206	11,000	....
Spruce,	8,000	.03	48 88	391	1,000	7,000
Cucumber,	3,800	.01	25 00	95	....	3,800
Cherry (black),	2,250	.01	91 56	206	2,000	250
Walnut (black),	1,400	....	91 42	128	1,100	300
Cypress (bald),	1,000	....	50 00	50	....	1,000
Walnut (Circassian),	500	....	350 00	175	....	500
Rosewood,	100	....	260 00	26	....	100
Total,	31,801,509	100.00	$42 63	$1,355,655	13,482,774	18,318,735

SHIPS AND BOATS.

The Delaware River's close and direct connection with the Atlantic Ocean as far up as Philadelphia affords sufficient depth and natural advantages to make that city one of the principal harbors of the Atlantic coast. All kinds of seafaring vessels land at its ports, including men-of-war and ocean liners, and railroads have located their terminal docks along its banks on the Pennsylvania side providing conveniences for the loading of coal, grain, and other commodities for export. In the western part of the State the Ohio River and its navigable tributaries afford excellent advantages for river navigation and accordingly the transportation of coal, sand, ore, lumber, steel, and other heavy freight for short hauls has become an important industry. Flat bottom boats are the kind used, such as packets, river tugs, barges, scows, flats, etc. A number of rivers in Pennsylvania, navigable only for small crafts, traverse parts widely known for their picturesque scenery. These are rarely used in commerce, but are inviting to the pleasure seekers for sailing, rowing, and canoeing. It is evident that in order to meet the local demand, the industry of ship and boat building in Pennsylvania must necessarily be varied. Crafts of all kinds are built in the State, from dreadnaughts and ocean steamers down to the shell used by the professional oarsmen.

In building large vessels, steel construction has, to a large extent taken the place of wood. Probably in no other industry has substitution been carried so far as in shipbuilding. It has been less than a century when wood for this kind of boat was the most important and valuable material used, and though still required, its use is only incidental and answers principally for decking, interior finish, furniture, masts, spars and booms, armor backing, templates, joinery work, etc. Smaller boats like steamers for inland water transportation, ferry boats, tugs, etc., use wood more extensively. Their hulls are of metal but their superstructure is mainly of wood while river crafts, scows, and barges are entirely of wood, and the same is true of small sail boats, canoes, launches, and other pleasure craft.

This industry not only supplies a large part of the local demand but boats built in Pennsylvania are sold world wide. Other states have more extensive harbor facilities, water fronts, and inland waterways than Pennsylvania, but are not comparable in the size and importance of their shipbuilding industry. In fact only one state surpasses Pennsylvania in the quantity of lumber consumed for boat building. New York in 1912 used 37,700,500 feet while other states in order for quantity are as follows:

Pennsylvania,	27,635,000
New Jersey,	13,341,000
Virginia,	11,138,000
Delaware,	7,679,000
Connecticut,	7,084,354

The uses of wood in boat building are multitudinous. In an ordinary schooner made of wood there are 500 different parts separately named. A large number of them require lumber with special qualities, which probably accounts for the long list of woods shown in Table 53. It is impossible to undertake to specify here the different woods for all parts of the many kinds of boats produced in the State but a few of the principal uses of lumber were mentioned by the boat builders and from their reports the following list has been arranged:

SHIPS, YACHTS, AND RIVER CRAFT.

Frames.
- White oak.
- Red oak.
- Hemlock.

Keels.
- White pine.
- White oak.
- Cypress.
- Hemlock.
- Red oak.

Knees.
- White oak.
- White ash.
- Sassafras.
- Tamarack.

Paddle Wheels.
- White oak.
- Yellow poplar.

Stern Posts.
- White oak.
- Tamarack.

Rudders.
- White oak.
- White pine.
- Cypress.

Planking.
- Cypress.
- White pine.
- Shortleaf pine.
- Douglas fir.
- Spruce.

Decking.
- Cypress.
- White pine.
- Hemlock.
- Douglas fir.

Rails.
- Teakwood.
- Mahogany.
- White ash.
- White oak.
- Longleaf pine.
- Hickory.

Masts.
- Spruce.
- Hemlock.
- Douglas fir.

Booms.
- Spruce.
- Hemlock.
- Douglas fir.
- Shortleaf pine.
- Longleaf pine.

Cabins (Interior).
- Chestnut.
- Mahogany.
- Teakwood.
- White ash.
- Sweet birch.
- Sycamore.
- Cypress.
- *Black walnut.
- *Circassian walnut.
- Butternut.

SHIPS, YACHTS, AND RIVER CRAFT—Concluded.

Cabins (Exterior).

- White pine.
- Yellow poplar.
- Hemlock.
- Douglas fir.
- Cypress.
- Longleaf pine.

Spars.

- Spruce.
- Hemlock.
- Douglas fir.

CANAL BOATS.

Cabins.

- White pine.
- Yellow poplar.
- Hemlock.
- Longleaf pine.

Frames.

- White oak.
- Red oak.
- Hemlock.

Decking.

- Longleaf pine.
- Hemlock.

Stern Posts.

- White oak.

Keels.

- White pine.
- White oak.
- Cypress.
- Douglas fir.
- Red oak.

Knees.

- White oak.
- White ash.
- Red oak.

Planking.

- Hemlock.
- Longleaf pine.
- Douglas fir.

BARGES, SCOWS, AND FLATS.

Frames.

- White oak.
- Red oak.
- Longleaf pine.

Bottom Boards.

- White pine.
- Spruce.
- Douglas fir.
- Red oak.

Planking.

- White pine.
- Spruce.
- Douglas fir.
- Red oak.

MOTOR BOATS.

Stems.

- White oak.
- White ash.

Keels.

- White oak.
- White ash.

Stern Posts.

- White oak.
- White ash.

Decking.

- Mahogany.
- White cedar.
- Spanish cedar.
- Cypress.
- White oak.

Deck Beams.

- White oak.
- Red oak.

Ribs.

- White oak.
- Red oak.
- White ash.

Coaming.

- White ash.
- White oak.

Planking.

- Cypress.
- White cedar.

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*Not reported.

CANOES AND SKIFFS.

Gunwales.
- Spruce.
- Mahogany.

Paddles.
- Spruce.
- Sugar maple.

Planking.
- White cedar.
- Spruce.
- Spanish cedar.

Ribs.
- White cedar.
- Spanish cedar.
- White ash.

Decks.
- White ash.
- Sweet birch.
- Sugar maple.
- Mahogany.

ROW BOATS.

Bottom Boards.
- Shortleaf pine.
- Douglas fir.
- Spruce.
- White pine.
- Cypress.

Sides.
- White pine.
- Douglas fir.
- Hemlock.
- Spruce.

Oars.
- Spruce.
- White ash.

Stern Posts.
- White oak.
- Red oak.
- Longleaf pine.

Transoms .
- Shortleaf pine.
- Spruce.
- Hemlock.
- White pine.

Seats.
- White pine.
- Longleaf pine.
- Shortleaf pine.
- Hemlock.

Longleaf pine is the principal species for shipbuilding. It is listed ahead of all other woods, not only in Pennsylvania but in all the important boat building states. Douglas fir is brought from the Pacific coast states especially for parts, as is seen above, requiring timbers of large dimensions and long lengths. It is easily worked, holds its shape, and, similar to longleaf pine, possesses great tensile strength and elasticity. The Pennsylvania ship builders demand more of this wood than is shown by the same industry in any other state. The same is true of hemlock and this is quite significant in that it serves principally for bottoms, planking, and other parts of river crafts for which white pine heretofore has been most extensively used. White pine still meets a portion of the ship builders' demands, irrespective of its growing price. Of the total amount used, 65 per cent. was reported as home grown. Mahogany, teak and Spanish cedar were the only foreign woods reported.

Table 53.—Wood for Ship and Boat Building, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Longleaf pine,	5,286,000	19.79	$37 56	$198,520	....	5,286,000
White pine,	4,544,650	17.01	46 85	212,928	2,733,150	1,811,500
Hemlock,	4,343,000	16.26	25 92	112,551	4,217,000	126,000
White oak,	3,871,400	14.49	34 73	134,436	2,230,900	1,640,500
Douglas fir,	2,521,000	9.44	42 41	106,926	....	2,521,000
Red oak,	2,434,000	9.11	35 24	85,770	1,180,000	1,254,000
Southern white cedar,	1,081,000	4.05	56 40	60,970	....	1,081,000
Spruce,	1,013,000	3.79	31 06	31,464	200,000	813,000
Shortleaf pine,	480,800	1.80	28 74	13,820	....	480,800
Ash,	388,700	1.45	41 47	16,118	262,700	126,000
Cypress (bald),	287,000	1.07	55 64	15,970	....	287,000
Basswood,	150,000	.56	16 00	2,400	150,000	....
Yellow poplar,	84,000	.31	58 07	4,878	2,500	81,500
Teak,	64,000	.24	190 66	12,202	....	64,000
Mahogany,	57,000	.21	164 39	9,370	....	57,000
Hickory,	28,000	.10	65 00	1,820	26,500	1,500
Sycamore,	20,000	.08	65 00	1,300	....	20,000
Redwood,	20,000	.08	52 30	1,046	....	20,000
Tamarack,	10,300	.04	45 73	471	300	10,000
Spanish cedar,	10,000	.04	250 00	2,500	....	10,000
Butternut,	10,000	.04	80 00	800	7,000	3,000
Sugar maple,	3,500	.01	29 14	102	2,500	1,000
Chestnut,	3,100	.01	27 10	84	3,100	....
Black gum,	3,000	.01	70 00	210	....	3,000
Beech,	2,500	.01	26 00	65	1,500	1,000
Sassafras,	50	*	25 00	1	50	....
Total,	26,716,000	100.00	$38 44	$1,026,722	11,017,200	15,698,800

*Less than 1-100 of 1 per cent.

CASKETS AND COFFINS.

This industry includes, in addition to caskets and coffins, outer or rough boxes and shipping cases. Caskets are the burial cases more universally used. Coffins, at one time in greater demand, are now but relatively seldom employed. They are irregular in form, widest at the part corresponding to the shoulders, narrowing slightly towards the head, and considerably at the feet. The statistics for Pennsylvania show not over 5 per cent. of the wood demanded by the manufacturers was for coffins. More than this amount is used, however, since many coffins are handmade. They are manufactured by cabinetmakers who cater for local trade in all small towns throughout the State. The quantity of wood used by one is small, but for a thickly populated state like Pennsylvania the aggregate consumption would amount to considerable, although it was found impracticable to collect statistics so widely scattered. Black walnut for many years has been the principal coffin wood and it is still called on for the better grades. Cheap coffins are of woods that are soft, easily worked, and at the same time adaptable to stain and polish. Yellow poplar is more used than any other kind for both factory and hand made coffins. in the southern states cypress is the leading coffin material, on the Pacific coast western red cedar, and in the Lake states basswood.

Twelve woods were reported by casket makers. They range from high priced mahogany down to low grades of chestnut and white pine. These burial cases are varied in design, some have an octagonal appearance—the corners instead of being rectangular are cut off and squared. Some have rounded corners, and others are uniformly rectangular. Nearly all are cloth covered and though this permits the use of the lower grades, the lumber selected is free from the defects which would likely affect the strength and durability of the casket. Chestnut is the most used casket wood in all states because it has proved especially durable under ground, and it possesses the combined qualities of lightness and strength, cheapness, and an affinity for glue that holds the cloth. Some of the chestnut used in casket manufacture is of the best, but the largest part is the "sound wormy" grade. As far as durability is concerned this grade is sufficient and the fact that it is perforated with the small worm holes averaging the size of a pin head is an advantage rather than a detriment, as in covering the casket these holes afford an additional hold for the glue. Other woods generally competing as casket material are yellow poplar, red oak, white cedar, cypress, red cedar, white pine, walnut, red gum, white oak, sugar maple, and mahogany. All of them go for cloth covered caskets and some answer for burial cases finished with natural appearance where the wood selected has a handsome grain and is susceptible to the highest polish, similar to that on piano cases. High priced caskets are of this kind and in addition the most expensive are richly carved. The Pennsylvania manufacturers use quartered red oak and white oak, mahogany, and walnut for making these and also to a limited extent red gum, which, from the price paid, must have been selected to imitate Circassian walnut.

The lumber used for outer cases, sometimes called rough boxes, and for shipping cases to protect the coffiin or casket in transit, is made of similar woods, but the latter are more carefully manufactured, stronger and neater in appearance. At their destination they serve as rough boxes to receive the casket when put into the ground. White pine in Pennsylvania meets most of the demand and yellow poplar next. Other species reported were western white pine, red cedar, hemlock, chestnut, red oak, and mahogany.

Table 54.—Wood for Caskets and Coffins, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Chestnut,	5,387,000	38.53	$20 57	$110,807	1,573,500	3,813,500
White pine,	4,793,000	34.28	28 90	138,495	703,500	4,089,500
Hemlock,	1,000,000	7.15	28 00	28,000	1,000,000	....
Yellow poplar,	748,000	5.35	32 10	24,008	432,000	316,000
Red oak,	665,000	4.76	40 44	26,890	55,000	610,000
White oak,	523,500	3.74	62 20	32,562	77,500	446,000
Mahogany,	331,000	2.37	76 30	25,255	....	331,000
Black walnut,	214,000	1.53	59 50	12,732	182,000	32,000
Red cedar,	169,000	1.21	66 72	11,275	....	169,000
Sugar maple,	35,000	.25	25 00	875	....	35,000

Table 54—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Red gum,	30,000	.22	40 00	1,200	....	30,000
Western white pine,	20,000	.14	42 50	850	....	20,000
Redwood,	20,000	.14	54 00	1,080	....	20,000
Cherry (black),	20,000	.14	60 00	1,200	20,000	....
Cypress (bald),	20,000	.14	40 00	800	....	20,000
Longleaf pine,	6,000	.04	37 50	225	....	6,000
Birch,	1,000	.01	24 00	24	1,000	....
Total,	13,982,500	100.00	$29 77	$416,278	4,044,500	9,938,000

MINE EQUIPMENT.

In conjunction with the operation of coal mining, there is usually maintained a wood-working department for the manufacture and repair of all wooden equipment required in connection with the work. Table 55 includes all the kinds of material used for these various purposes except that used in the rough, as props, lagging, caps, segments, sills, etc. In the interior of the mines lumber goes for uses in connection with ventilation schemes; brattices, doors, airways, manways, and for pit railing, etc. On the breakers in collieries it is used for tipple parts, drum bands, chutes, screens, scraper lines, flights, etc., besides it answers for parts of haulage systems, slope rollers for example, and for sprags and various other less important commodities. The lumber used for mine cars and their repair has been included as shown above, under car construction, while that going into manufactured parts for houses, buildings, and other building operations was listed with similar material under the planing mill industry. The available statistics reported by both anthracite and bituminous operations in Pennsylvania are as follows:

Table 55.—Wood for Mine Equipment, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Hemlock,	2,260,750	18.92	$20 82	$47,066	2,260,750	....
White oak,	2,019,927	16.91	18 22	36,805	2,019,927	....
Black gum,	1,628,460	13.63	24 37	39,678	219,216	1,409,244
Hickory,	816,363	6.83	13 51	11,031	816,363	....
Red oak,	807,845	6.76	14 73	11,892	807,845	....

Table 55—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Sugar maple,	790,200	6.61	18 67	14,751	790,200	....
Chestnut,	749,405	6.27	15 42	11,557	749,405	....
Beech,	656,525	5.50	17 49	11,781	656,525	....
Shortleaf pine,	567,000	4.75	21 14	11,983	....	567,000
Longleaf pine,	423,000	3.54	26 39	11,163	....	423,000
Birch,	336,075	2.81	24 23	8,143	336,075	....
Pitch pine,	246,000	2.06	23 07	5,675	246,000	....
White pine,	239,000	2.00	23 70	5,665	13.000	226,000
Red gum,	150,000	1.26	12 00	1,800	....	150,000
Dogwood,	139,088	1.16	15 73	2,188	139,088	....
Ash,	43,425	.36	22 01	956	43,425	....
Locust,	31,350	.26	10 18	319	31,350	....
Hornbeam,	21,684	.18	13 14	285	21,684	....
Yellow poplar,	14,000	.12	22 50	315	14,000	....
Cork elm,	8,800	.07	26.14	230	8,800	....
Total,	11,948,897	100.00	$19 52	$233,283	9,173,653	2,775,244

Two commodities included in the above table deserve special mention and to show the kinds of wood used in making them, separate statistics have been arranged and are presented in the supplemental tables, 55a, mine rollers, and 55b, sprags.

MINE ROLLERS.

Table 55a shows seven woods going into slope rollers. They aggregate nearly 2,500,000 feet of material used annually, but this does not represent wood for rollers that are manufactured elsewhere and brought to the State ready for use. Slope mining in recent years is being superseded by the shaft method and with the change is a corresponding decline in the demand for rollers or pulleys used on the slope to prevent abrasion of the cable against the ground. Two-thirds of the roller material is black gum. That obtained from timber cut in the State is mostly the species, *Nyssa sylvatica*, but that coming from a distance, usually in the form of bolts, is a mixture of the above named species with water gum *(Nyssa biflora)*, and a small amount probably of tupelo *(Nyssa aquatica)*. Black gum is frequently the common name for all three. The first two species are the most desirable for rollers because of their interlaced fiber that will not splinter nor roughen but wears smooth to a polish by use. Further than this, the woods possess the superior qualities of hardness and toughness, and on account of their abundance, especially in the southern states, are the lowest priced hardwoods. Maple is especially adapted for slope rollers, but owing to its growing scarcity and high price black gum has largely superseded it. Formerly maple was the most used wood for the purpose, but the table shows that the demand for it at present is only one-sixth of that of black gum.

Veneer cores, the symmetrically round pieces left after the veneer has been removed by the rotary cut process, are now being used for making mine rollers, when the species is one of the black gums. These cores are an off-fall that represents to a large degree a complete waste and the fact that they are suitable for this line of manufacture should certainly be a means of utilizing a large quantity of this discarded material.

Table 55a.—Wood for Mine Rollers, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Black gum,	1,623,960	66.54	$24 38	$39,588	219,216	1,404,744
Sugar maple,	277,200	11.36	26 99	7,482	277,200	....
White oak,	212,080	8.69	30 57	6,483	212,080	....
Birch,	183,200	7.51	30 70	5,624	183,200	....
Beech,	123,200	5.05	30 84	3,799	123,200	....
Yellow poplar,	12,000	.49	18 75	225	12,000	....
Cork elm,	8,800	.36	26 14	230	8,800	....
Total,	2,440,440	100.00	$25 99	$63,431	1,035,696	1,404,744

SPRAGS.

This is a second division of this industry which deserves special attention, not that it represents a commodity that is important in the amount of wood consumed nor economically prominent in the operation of large factories and the use of skilled labor, but because it serves to illustrate the tendency in Pennsylvania towards waste utilization.

A sprag is a cylindrical wooden commodity pointed at each end, about 21 inches long, ranging in thickness from 2¼ to 3¼ inches and is used in coal mining operations for checking and regulating the speed of a mine car as it runs in and out of the laterals leading to the shafts. The speed of the car is checked by locking one of its wheels. This occurs when the sprag, having been cast between the spokes of the rotating wheel, strikes against the car still.

Mine cars are not equipped with brakes like freight cars and upon the sprag often depends the safety of the car and more often a train when running downgrade. Sprags must therefore necessarily be very strong and many companies are particular in the specifications of their orders for manufacturing them. Small sprags of not proper thickness are a slight economy, if any, as the frequent breakages entail considerable waste. Also the species of wood used for making them, if not of the requisite strength, hardness, and durability, would in nowise pay in service the expenses of making the sprags.

This industry excludes the softwoods and a number of soft hardwoods, like aspen, yellow poplar, basswood, etc. Chestnut is not suitable owing to lack of sufficient strength, though if easily available and very cheap, it is used to a limited extent. The most practical sprag woods, listed according to amounts, are given in Table 55b following:

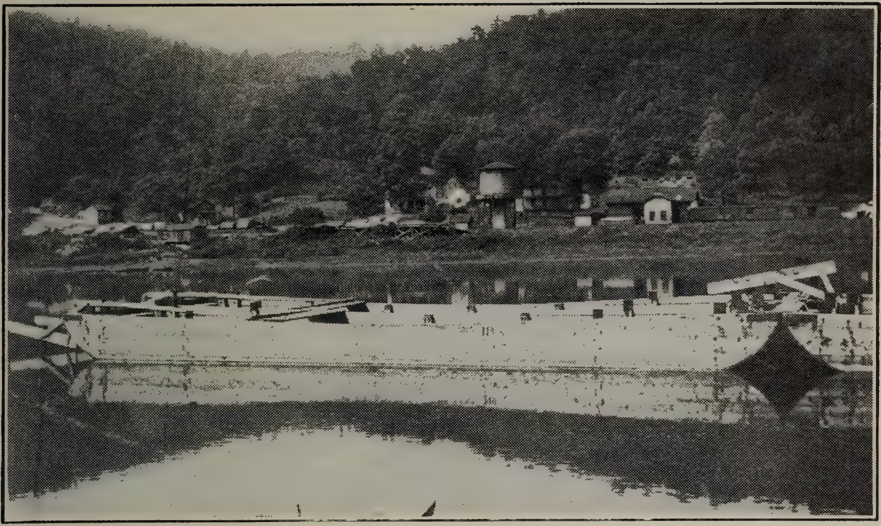

Fig. 12.—River scows after being launched, and ready to be taken to market down the Allegheny River.

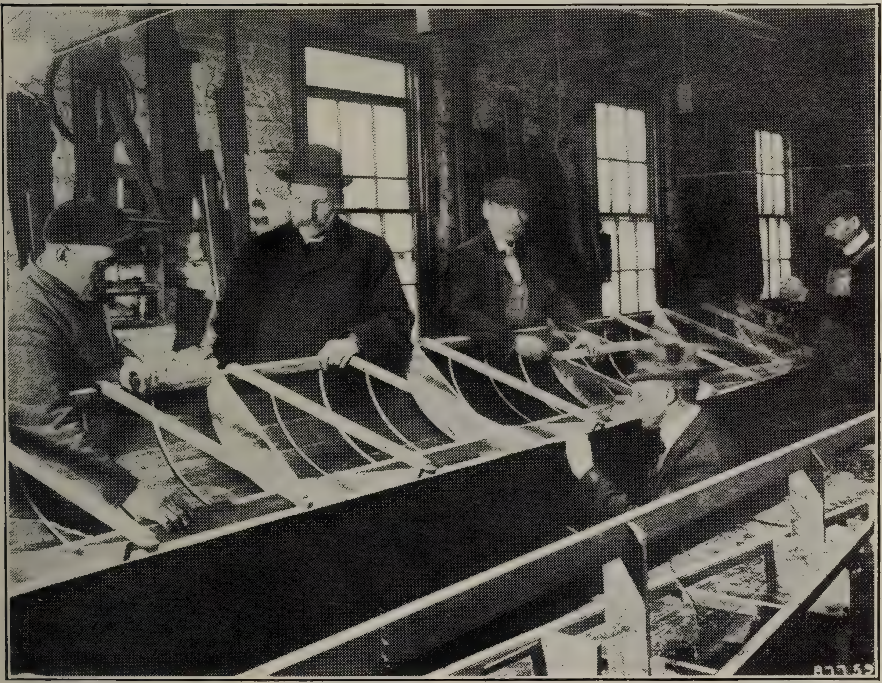

Fig. 13.—Racing shell being built by a Pennsylvania manufacturer for the University of Pennsylvania.

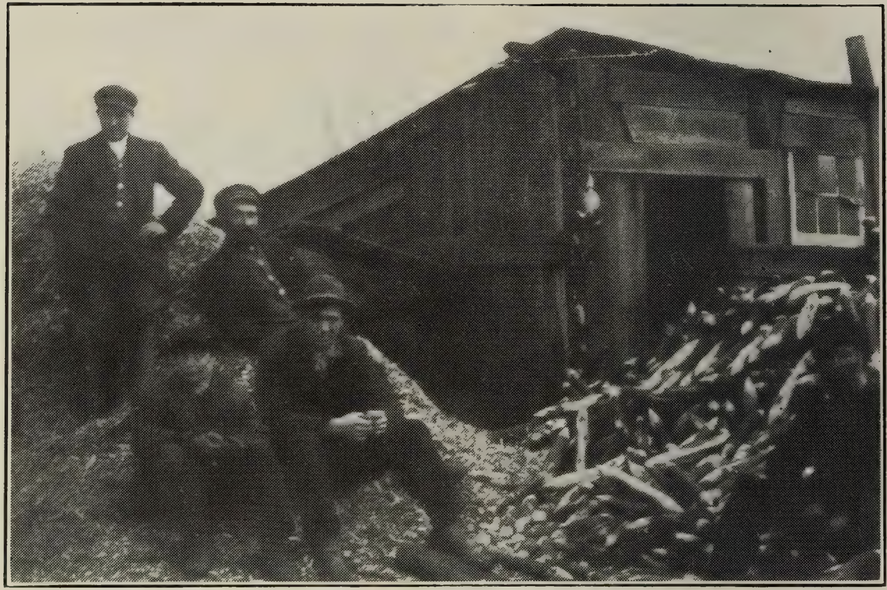

Fig. 14.—Manufacture of mine sprags in Northern Pennsylvania.

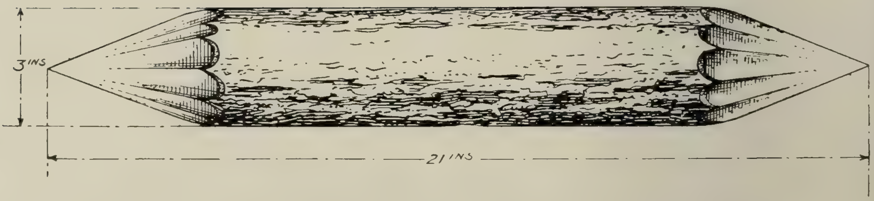

Fig. 15.—Drawing showing standard dimensions of a mine sprag.

Table 55b.—Wood for Sprags, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White oak,	1,091,847	34.27	$14 00	$15,286	1,091,847	....
Hickory,	816,363	25.62	13 51	11,031	816,363	....
Red oak,	612,845	19.23	14 18	8,701	612,845	....
Sugar maple,	304,200	9.55	13 55	4,121	304,200	....
Dogwood,	139,088	4.37	15 73	2,188	139,088	....
Beech,	92,325	2.90	10 71	989	92,325	....
Ash,	37 425	1.17	21 54	806	37,425	....
Locust,	31,350	.98	10 18	319	31,350	....
Chestnut,	23,205	.73	16 42	381	23,205	....
Hornbeam (ironwood),	21,684	.68	13 14	285	21,684	....
Birch,	10,875	.34	14 62	159	10,875	....
Black gum	4,500	.14	20 00	90	....	4,500
Hemlock,	750	.02	13 33	10	750	....
Total,	3,186,457	100.00	$13 92	$44,366	3,181,957	4,500

Over 3,000,000 feet of wood is required annually for making sprags in Pennsylvania. This is not representative of all the material that is used as many of these commodities are made by hand and concerning which it is impossible to get information; others are made elsewhere and shipped in for use in Pennsylvania collieries.

Sprags at present are almost entirely made from young timber, pole size; coppice oak and maple being cut for this purpose. This is often a sacrifice of valuable second growth timber since it is practicable to make this commodity from material considered as waste. In that connection the present report may aid in bringing about the utilization of woods waste, like tops, limbs, cut offs, fire killed poles, etc., the most difficult to market of all the off-fall from lumber operations.

In this connection the Department of Forestry of Pennsylvania recently made a valuable experiment, an outline of the results of which will prove of considerable importance not only to mining companies and others owning their own timber, but to all interested in forest conservation.

During the winters of 1911-12 fire killed a stand of oak and chestnut coppice 14 years old on 75 acres in one of the State Forests in the northeastern part of Pennsylvania. This timber was not merchantable because of the size and distance from market. The Department of Forestry conceived the idea of its sale in the form of sprags and accordingly arrangements were made with an owner of a sprag machine to move onto the tract and use all suitable timber for making this commodity. A contract was made for manufacturing and delivering the finished product to the nearest shipping point for $9.30 which included, owing to distance, a cost of $4 for wagon transportation. Eleven dollars was the price received for the finished sprags at the siding, leaving a balance of $1.70 a thousand pieces for stumpage. The Department of Forestry scored a success in the undertaking partly because of the revenue received from the fire killed timber, otherwise a waste; also by this operation a vast amount of what would otherwise have been debris was removed from the woods, assuring less of a tangle when the trees fell and thus allowing a closer fall to the ground and quicker decomposition.

Ten years ago sprags were made with ax and knife, 200 per day being the most one man could produce. Repeated efforts were made to eliminate the manual work by the invention of machinery, but it was not until four years ago that a manufacturer made a successful device which, with the work of two men, enables a possible daily output of from eight to nine thousand sprags. In ordinary commercial runs, however, the average production with this machine is probably not over half the capacity.

FIXTURES.

The fixture manufacturers make certain lines of commodities so closely related to similar ones grouped under the furniture and planing mill industries, that it is difficult at times to determine under which classification they properly belong.

Generally fixtures include furnishings for offices, stores, lodge rooms, saloons, banks, hotel lobbies, lunch rooms, courthouses, churches, dentists' and surgeons' cabinets, account registers, cash registers, index files, and other similar commodities. The materials for making these are distinguished from that going into high class inside house finish such as mantels, colonnades, cabinet work, and general mill work. The latter are stationary, while fixtures are readily portable. From furniture woods they are separated according to the uses of the finished products. Office desks, book cases, store tables, etc., belong to furnishings of business headquarters while commodities of the same name for residences go in the furniture class. Large manufacturers specialize in one or the other lines but in small cities and towns where the local demand does not justify specialization the fixture makers and the planing mills manufacture products belonging to both industries.

Nearly the same woods are employed for fixtures as for furniture but a larger part of the fixture material is of the higher grades. In both industries the woods can be put into two classes, for outside finish and for interior or hidden work. Veneers enter largely into the former class and are growing in favor, chestnut being the favorite backing or core material. For painted work or store counters, bar tops, display racks, show window platforms, and other fixture parts, it is necessary to use solid wood instead of cheaper woods overlaid with veneer. This accounts for the average prices of the woods listed in Table 56 being higher than in the furniture industry.

Yellow poplar, white oak, red oak, and chestnut supply the largest portion of the fixture material in Pennsylvania. Seventy-five per cent. of the quantity used is of these four kinds. Yellow poplar serves both for exterior and interior work. Its adaptability to hold paint and stains, its soft texture and even straight grain make it an easy material to smooth and commend it probably above any other wood for both exterior enameled work and for drawer bottoms, reinforcements, hidden parts of show cases, shelving, interior of wall cases, partitions, etc.

Oak with its ornamental figure is universally the premier fixture wood as it is the foremost furniture wood. Both classes of oaks, red and white, are in demand, and together the amount is greater than that of any other of the woods the Pennsylvania fixture makers purchase. A large part of oak is quartered stock which merely designates the method of sawing. It is the same as rift sawed and arises from first cutting the log into quarters and the quarters into boards, the saw crossing the circles of growth at or nearly at right angles. Oak shows more figure when the log is sliced ordinarily into boards but the pleasing effect of rift sawing is more in favor and besides being desired by the fixture makers on account of minimum shrinkage and warp. Birch is ahead of any other domestic wood for imitating mahogany. The heartwood of the tree is used for this work. The sapwood has a much lighter color but like the heartwood is specially adapted to take stain and receive and hold a soft brilliant polish. Besides mahogany, birch can readily be stained to imitate cherry, Circassian walnut, fumed oak, bog oak, black walnut, and other pleasing effects. The figure of curly birch is especially attractive and it brings high prices, going into the highest grades of fixtures. Other finishing woods are mahogany, sugar maple, including large quantities of bird's eye maple, cherry, red gum, black walnut, butternut, and Circassian walnut. The last named is the most expensive wood and goes only into the most expensive work. Red gum and butternut are frequently found richly mottled and in some respects resembling Circassian walnut. For that reason they are most frequently used of any domestic wood to be finished in imitation of this foreign wood.

This industry calls on the State for only a limited portion of its raw material. Only a little more than one-third of the total was reported as home cut and of the entire amount of eleven of the woods shipped in from other states, two-thirds were oak and yellow poplar which being demanded in high grades made it necessary to obtain a large portion in regions where the virgin stands of these species are the most abundant. States in the southern Appalachians furnished most of this material. Of the woods listed in the fixture table that are abundantly cut in Pennsylvania the chestnut, birch, sugar maple, basswood, cherry, beech, ash, black walnut, and butternut, most of the supply used was State-grown. The fixture manufacturers, therefore, like the other class of manufacturers using home-grown material should be vitally interested in conservation and the movement looking to the State's future timber supply.

Table 56.—Wood for Fixtures, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Yellow poplar,	2,237,000	18.82	$37 21	$83,229	167,500	2,069,500
White oak,	2,127,110	17.89	59 79	127,184	303,600	1,823,510
Red oak,	2,100,950	17.67	41 36	86,902	509,500	1,591,450
Chestnut,	1,803,350	15.17	25 16	45,364	1,114,250	689,100
Birch,	832,300	7.00	36 60	30,461	438,500	393,800
White pine,	452,450	3.81	45 64	20,649	100,450	352,000
Sugar maple,	366,000	3.08	23 17	8,482	317,500	48,500
Mahogany,	332,400	2.80	135 11	44,910	....	332,400
Basswood,	269,100	2.27	33 92	9,128	176,100	93,000
Red and silver maple,	260,000	2.19	15 00	3,900	260,000	....
Shortleaf pine,	256,000	2.15	25 92	6,635	....	256,000
Loblolly pine,	153,000	1.29	22 17	3,392	....	153,000
Cherry (black),	128,700	1.08	66 14	8.512	83,250	45,450
Cypress (bald),	111,800	.94	37 38	4,179	....	111,800
Red gum,	94,000	.79	44 00	4,136	....	94,000
Beech,	71,000	.60	21 85	1,551	60,000	11,000
Ash,	49,900	.42	58 62	2,925	41,000	8,900
Hemlock,	44,300	.37	26 64	1,180	30,300	14,000
Cottonwood,	40,000	.34	38 50	1,540	20,000	20,000
Longleaf pine,	39,500	.33	32 41	1,280	....	39,500

Table 56—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Black walnut,	35,860	.30	82 91	2,973	28,860	7,000
Sugar pine,	25,000	.21	65 00	1,625	....	25,000
Western white pine,	20,500	.17	46 78	959	....	20,500
Pitch pine,	20,000	.17	16 00	320	20,000	....
Butternut,	13,500	.11	44 30	598	13,500	....
Spruce,	1,500	.01	42 00	63	....	1,500
Black gum,	1,000	.01	28 00	28	....	1,000
Hickory,	1,000	.01	65 00	65	1,000	....
Redwood,	500	*	55 00	28	....	500
Circassian walnut,	500	*	250 00	125	....	500
Total,	11,888,220	100.00	$42 25	$502,323	3,685,310	8,202,910

*Less than 1-100 of 1 per cent.

CLOTH, HOSIERY BOARDS, ETC.

Cloth boards, commonly called wrapping boards, upon which to wind woolen and other textile goods, hosiery boards used in stocking factories and stores, hammer boards for beating brass and other sheet metals, and lap boards used by the seamstress, are the commodities which have been classed under Table 57. The largest part of the total was for cloth boards and the species used were loblolly pine, shortleaf pine, yellow poplar, and white pine. The size of cloth boards varies from 6 to 8 inches wide and from 16 to 20 inches long and one-fourth to five-eights of an inch thick.

Sugar maple supplies the entire demand for hosiery boards or driers. They are made of ¼ inch material which is strong, dense and not liable to roughen up or splinter. Yellow poplar sufficed for sewing or lap boards and for stocking forms. Because maple does not split easily and is strong and hard, it is preferred of all woods for hammer boards. Considerable material is used in Pennsylvania for the manufacture of ironing and sleeve boards, meat, pastry, and steak boards or planks, but these have been listed and referred to under the industry entitled "Woodenware."

Table 57—Wood for Boards, Cloth, Hosiery, etc., year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Shortleaf pine,	8,000,000	67.94	$25 00	$200,000	....	8,000,000
Yellow poplar,	1,070,000	9.09	29 38	31,440	....	1,070,000
White pine,	1,000,000	8.49	32 00	32,000	....	1,000,000
Loblolly pine,	1,000,000	8.49	18 13	18,125	....	1,000,000
Sugar maple,	705,000	5.99	46 45	32,750	50,000	655,000
Total,	11,775,000	100.00	$26 69	$314,315	50,000	11,725,000

PATTERNS AND FLASKS.

Table 58 shows that nearly eleven and a half million feet of lumber are required annually in Pennsylvania for making patterns, flasks, and for other needs of the moulders and foundrymen. Of this amount nearly 80 per cent. is white pine. All of this did not go for patterns, since white pine was demanded for flasks in greater amounts than was any other wood. It is, however, the predominant pattern wood not alone in Pennsylvania, but throughout the country at large. Its suitability is due above all to its susceptibility to hold shape under atmospheric changes, to its grain being close, straight, and even, with obscure figure, to its being easily worked, and at the same time not so soft as to be injured by rough usage, and to its being light in weight and easily portable. Since the pattern must be designed in the exact shape and dimensions of the article to be moulded, the highest grades of lumber are required, and, in many cases, material of considerable width is required and is usually often quarter-sawed, which will not warp as easily as straight sawn lumber cut without regard to grain. These are the factors which have increased the cost of this species to the point of creating a demand for a substitute wood. Thus far no kind of wood experimented upon has been equal to white pine. It will be noticed that the western white pine cut in the Rocky Mountains appears in the table and also the sugar pine of California. Neither of these woods can be distinguished at sight from the eastern white pine. The western white pine is heavier than the eastern, and the sugar pine more resinous. The kinds of wood used for patterns in Pennsylvania are as follows:

White pine.
Cherry.
Mahogany.
Sugar maple.
Sugar pine.
Western white pine.
Redwood.
Yellow poplar.
White oak.
Black walnut.
Butternut.
Teak.
Silver maple.

Standard patterns, or patterns used often and therefore submitted to considerable wear, are made as durable as possible. For these very hard dense wood is required and mahogany, cherry, butternut, sugar maple, black walnut, and teak wood—the latter a foreign wood—are the ones used in Pennsylvania. Large patterns, like those for moulding massive machine parts can not with economy be used entirely of these woods. Only the parts that come in direct contact with the sand, where the greatest wear is, are made of hardwoods, the inside or filler being of a softer, cheaper wood, and one more easily worked, such as white pine, sugar pine, yellow poplar, or redwood. Mahogany is the best of the hardwoods for patterns, though cherry is the favorite of the domestic woods. These are of even straight grain and less liable to shrink and swell when enclosed in the matrices of damp sand. In addition they stand well the ramming, knocking, and rough usage a standard pattern receives. Sugar maple would be more used than it is were it not for its tendency to warp. Being hard, of straight, compact structure, with a capacity to wear smooth, and easily worked, it otherwise possesses excellent qualities for pattern material.

For flasks lower grades of lumber are required than for patterns. Flasks serve as the frame or box, holding the sand in which to make the mould. A two-part flask is used when the pattern is in two pieces, one resting upon the other, the upper part is the cope, the lower the nowel. Flask material does not last long, its destruction being due more to frequent burning than to the general rough wear. The firing results from intense heat of the sand after the molten metal is poured into the mould. Buckets of water are conveniently at hand to extinguish a blaze as soon as it is discovered. Wood slow to take fire is the best flask material, though choice is usually limited to kinds near at hand or that are cheap. Redwood, when not too costly is preferred, because it is generally conceded to be more fireproof than any other domestic wood. Coating the inside of flasks with a fireproof chemical has been tried recently as an experiment. Flask woods in order of their importance in Pennsylvania are as follows:

White pine.
Loblolly pine.
Hemlock.
Shortleaf pine.
Longleaf pine.
Yellow poplar.
Spruce.
Chestnut.
White oak.
Pitch pine.
Norway pine.
Sugar maple.
White elm.
Red oak.
Beech.

The Pennsylvania forests furnished only one-fourth of the total pattern material used. This was probably due to the diminishing stand of white pine timber in the State of the size demanded by the high grade lumber pattern makers. Nearly seven-ninths of all that was used was shipped in from West Virginia, the Great Lakes region, and western states.

Table 58.—Wood for Patterns and Flasks, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White pine,	9,141,449	79.53	$56 09	$512,735	2,276,198	6,865,251
Loblolly pine,	579,000	5.04	20 27	11,738	....	579,000
Hemlock,	291,500	2.54	18 37	5,356	291,500	....
Shortleaf pine,	242,012	2.11	20 89	5,056	....	242,012
Longleaf pine,	234,000	2.04	20 70	4,844	....	234,000
Spruce,	223,988	1.95	33 63	7,533	44,000	179,988
Redwood,	136,000	1.18	60.74	8,260	....	136,000
Chestnut,	128,200	1.11	19 24	2,466	47,500	80,700
Cherry (black),	86,894	.76	71 58	6,220	54,644	32,250
Mahogany,	86,268	.75	124 92	10,777	....	86,268
Sugar maple,	50,550	.44	47 46	2,399	38,850	11,700
Sugar pine,	50,000	.43	85 00	4,250	....	50,000
Yellow poplar,	46,500	.40	38 82	1,805	37,500	9,000
Pitch pine,	44,000	.38	20 84	917	41,500	2,500
Norway pine,	43,040	.37	28 00	1,205	....	43,040
Western white pine,	28,000	.24	56 93	1,594	....	28,000
White oak,	24,000	.21	39 50	948	24,000	....
White elm,	15,000	.13	33 00	495	....	15,000
Black walnut,	14,500	.13	50 00	725	4,500	10,000
Red oak,	12,000	.10	25 00	300	12,000	....
Beech,	10,000	.09	25 00	250	10,000	....
Butternut,	5,210	.05	79 85	416	3,900	1,310
Teak,	1,400	.01	250 00	350	....	1,400
Red and silver maple,	1,000	.01	55 00	55	1,000	....
Black gum,	500	*	24 00	12	....	500
Total,	11,495,011	100.00	$51 39	$590,706	2,887,092	8,607,919

*Less than 1-100 of 1 per cent.

HANDLES.

Other states take precedence over Pennsylvania in the quantity of wood annually consumed in the manufacture of handles, but it is probable that none surpasses it in the different kinds of handles made. The principal ones reported have been listed and the woods from which they are made arranged in order of quantity as follows:

Axe Handles.
White ash.
Hickory.
White oak.

Brick Trowel Handles.
Dogwood.
Persimmon.

Broom Handles.
Basswood.
Beech.
Sugar maple.
Birch.

Butcher Knife Handles.
Birch.
Beech.
Sugar maple.

Cant Hook Handles.
Sugar maple.
Hornbeam.
Hickory.

Carrying Poles.
Hornbeam.
Hickory.

Chisel Handles.
Hickory.

Coal Pick Handles.
White oak.
Sugar maple.
White ash.
Sweet birch.
Hickory.

Concrete Rammer Handles
Hickory.
Hornbeam.

Crosscut Saw Handles.
Beech.
Sugar maple.
Hickory.

Door Knobs.
Sugar maple.

D-Fork Handles.
White ash.

D-Shovel Handles.
White ash.
Sugar maple.

Fork Handles.
White ash.
Cherry.

Grab Maul Handles.
Hornbeam.
Hickory.

Hammer Handles.
White ash.
Hickory.

Hatchet Handles.
Hickory.
White ash.

Hay Knife Handles.
White ash.

Hoe Handles.
White ash.
Sugar maple.
Beech.
Birch.

Instrument Handles.
Rosewood.
Ebony.

Jack Handles.
Hickory.
Sugar maple.

Mallet Handles.
Dogwood.
Hornbeam.
Hickory.

Maul Handles.
Hickory.

Mop Handles.
Beech.
Sugar maple.
Birch.
Basswood.

Peavey Handles.
Hornbeam.
Hickory.

Pick Handles.
Hickory.
White oak.
Hornbeam.

Pipe Wrench Handles.
Basswood.

Plastering Trowel Handles.
Basswood.

Pole Brush Handles.
Basswood.
White ash.
Shortleaf pine.

Rake Handles.
Sugar maple.
Beech.
Birch.
Ash.

Saddler's Tool Handles.
Black walnut.

Sad Iron Handles.
Red gum.

Sand Rammer Handles.
Hickory.
Hornbeam.

Saw Frames.
Red Oak.
Birch.
Sugar maple.

Saw Handles.
Red gum.
Sweet birch.
Applewood.
Beech.

Spade Handles.
White ash.
Black ash.

Spud Handles.
Hickory.
Hornbeam.
Sugar maple.
Beech.

Stomper Handles.
Hornbeam.
Hickory.

Street Brooms.
Beech.
Sugar maple.
Hickory.

Track Tool Handles.
White oak.
Hickory.
Sugar maple.
White ash.

Hickory is unquestionably the best wood used for long-handle tools, including the maul, axe, striking hammer, sledge, and track tools used on railroads for construction work and for maintenance of way. Besides exceptional strength, this wood possesses other important qualities for handle material,—weight, stiffness, shock-resisting ability, and susceptibility to wear smooth by use. Manufacturers of this class of handles usually specialize in this line, since the processes of manufacture and the machinery required are distinct from those employed in making other classes. Hickory is becoming scarcer each year, and this fact has induced a number of northern handle makers to move southward nearer to the source of the largest supply. Not a few firms, however, continue to maintain factories in the north and to ship billets, bolts, and rough-turned handle stock from the south to the north as far as Connecticut and New Hampshire.

It is interesting to note from the following table that the Pennsylvania hickory handle manufacturers procure 66 per cent. of their raw material from the State. It would be well for farmers and timber owners in Pennsylvania who own stands of hickory to understand the increasing demand for the wood for handles and that second-growth hickory is preferred. This tree is not a rapid grower but it is not so slow as many other trees and it will soon prove a good investment to preserve stands of second-growth hickory to aid their development, and to cut the timber only as it becomes large enough for handle bolts. The list given below shows the kinds of wood which are being tried as substitutes for hickory in handle making, white oak, cow oak, swamp oak, sugar maple, hornbeam, and ash being the principal ones. For coal-pick handles these woods are suitable and most largely used, there being less strain as to strength and shock-resisting than if used for the more strenuous work of the pick, axe, and maul.

The manufacture of fork and garden tool handles is another distinct class of this industry. What hickory is for the axe, pick, and sledge, white ash is to this class, namely, the pitch-fork and hay-fork, the long handle and D-shovel, and the hoe, rake, etc. Stiffness, toughness, and strength without excessive weight are the properties which commend ash for this use. It is surprising that the handle manufacturers demanding this wood procure only 58 per cent. of their requirements from State-grown woods. This condition offers another opportunity to timber owners to encourage the growing of ash for handle stock, to meet the demand of the increasing home market. In forest management ash is an important tree. It is a fairly rapid grower and is not particular as to situation, as are many other trees.

Other woods serve with ash for meeting the demand for this class of handles, but they are used in considerably smaller quantities. In the order of their importance, they are sugar maple, beech, birch, and cherry. In other states elm, sycamore, and soft maple are included.

More wood in Pennsylvania is required for broom and mop handles than for any other class, and like hickory handles, the manufacturer makes no other kinds. The maples, chiefly sugar maple, the birches and beech because they turn well and wear smooth in use, and to a less extent, basswood, red gum, ash, and sycamore, are the broom and mop handle woods; and all of them are reported being used in Pennsylvania. Sugar maple is preferred and only a few years ago was most used. Its demand for other uses at higher prices is probably the chief cause for bringing birch into first place. High grade material is required for broom handles and squares are usually cut direct from the log, the less desirable being put into mop handles. Mop handle squares were found being bolted in Pennsylvania from slabs and edgings of sawmills cutting beech, birch, and maple.

For handles where weight is not an objection and strength is the foremost consideration, hornbeam or ironwood has been found very satisfactory. Cant hook and peavey handles, stomper and rammer handles are examples.

Applewood is very well adapted for handsaw handles, being hard, sufficiently strong, of uniform texture, and susceptible of high polish. The attractive uniform color has caused it to become the principal wood for better grades of handles. Red gum, cherry, and sweet birch have proved satisfactory for saw handles, but more because they can be finished to resemble applewood closely than because of any other special quality which they possess. Beech furnishes the material for cheaper grades. Its color is against it and also the fact that it is not capable of high polish, but its toughness and greater strength and ability to wear smooth probably make it nearly equal to applewood. Other woods used for saw handles but not reported in Pennsylvania are mahogany and black walnut. Saw frames for buck saws are of red oak, birch, and maple and handles of crosscut saws are of sugar maple, hickory, and beech.

The bricklayers' trowels have handles of dogwood and persimmon. These woods are dense in structure and among the hardest domestic woods and therefore best stand the wear for use as a hammer for imbedding the brick into mortar after placing it. The plaster trowels are made of basswood. Being porous this wood absorbs the moisture from the wet hand of the mechanic and it is claimed does not slime. In the New England states popple or aspen is used for the same reason.

Table 59.—Wood for Handles, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Hickory,	3,973,350	36.07	$31 97	$127,045	2,599,300	1,374,050
Sugar maple,	2,307,850	20.95	19 02	43,897	1,727,700	580,150
Ash,	1,969,750	17.88	28 45	56,032	1,130,750	839,000
Beech,	1,752,300	15.91	17 31	30,412	1,302,800	449,500
Hornbeam,	415,500	3.77	49 53	20,580	315,500	100,000
Birch,	207,750	1.89	18 13	3,766	205,250	2,500
Red gum,	195,000	1.77	29 38	5,730	....	195,000
White oak,	59,000	.54	27 42	1,618	59,000	....
Applewood,	50,000	.45	40 00	2,000	25,000	25,000
Basswood,	41,200	.38	29 73	1,225	41,200	....
Red oak,	15,000	.14	17 50	263	15,000	....
Shortleaf pine,	12,000	.11	30 00	360	....	12,000
Cherry (black	7,500	.07	50 00	375	2,500	5,000
Persimmon,	7,000	.06	54 00	378	....	7,000
Black walnut,	1,050	.01	81 90	86	1,050	....
Ebony,	327	*	305 81	100	....	327
Dogwood,	230	*	67 57	16	....	230
Rosewood,	100	*	360 00	36	....	100
Total,	11,014,907	100.00	$26 68	$293,919	7,425,050	3,589,857

*Less than 1-100 of 1 per cent.

LAUNDRY APPLIANCES.

The fourteen woods demanded by the Pennsylvania manufacturers for making laundry accessories are listed in Table 60 following and they aggregate a cut of over nine million feet. Four woods, sugar maple, beech, birch, and yellow poplar, contributed nearly 70 per cent. of the total. Of these sugar maple is the most important, in quantity furnishing more than one-half of the entire demand. Four woods were cut entirely outside of the State but nearly three-fourths of the aggregate employed grew in Pennsylvania, showing to what extent this industry is dependent upon the forest resources of the State and why manufacturers should be interested in the movement to protect and improve the forests.

Clothespins are the smallest commodity grouped under this heading but they are not the least important as more wood is used for their manufacture than for any other laundry product. Over four million feet is the amount annually required. Fine grained beech and sugar maple in nearly equal quantities were the principal woods used. The other kinds include birch and yellow poplar. The last named and maple also are used for making clip pins, which are two wooden scales held together by a wire spring. The woods used in Pennsylvania as clothespin material are the same as those used in other states except in Virginia where the manufacturers report black gum, both the water gum and cotton gum varieties, which in those parts are indiscriminately called black gum. Three processes are necessary in the manufacture of clothespins, (1) the rough billets are turned to proper form, (2) they are put through another machine which slits them, (3) they are finally consigned into revolving cylinders to be tumbled or smoothed by abrasion.

Ironing boards and stands are an important part of this industry and the woods used are selected according to their fitness for the several parts. The frames or the collapsible stand upon which the boards rest require a strong wood and one that turns readily. Sugar maple and beech are reported in Pennsylvania while in Michigan elm and yellow birch joined with these in furnishing this material. Ironing boards are preferably of a wood that is soft and easily smoothed and one that in the presence of high temperature holds its shape well. It should be made of light weight wood so as to be easily portable. Cottonwood answers well but buckeye, basswood, yellow poplar, and white pine are probably the favorites. Besides regular-size ironing boards, these woods were also reported for skirt and sleeve boards used for specialty work.

Beech, birch, and maple, because they are strong, tough, and not easily split, were reported for making clothes racks, sometimes called horses, and for clothes driers. Light weight wood like basswood or aspen were used for the stringers. The racks are made of turned stock and fold together like a screen. The driers are revolving reels through the arms of which wire is strung for hanging clothes. These include the ones that are temporarily attachable to back porches of apartment buildings and also the kinds that are placed in back yards. Adjustable curtain stretchers used in laundering lace and other thin fabric window curtains are included in this industry. Basswood was the only wood used while a large amount of loblolly pine was called on for clothes props.

Mangles are ironing machines used for domestic purposes in ironing flat work such as table and bed linen, towels, handkerchiefs, etc. In appearance they resemble clothes wringers, having their rolls operating at a tangent. Some of them are intended only for cold ironing or smoothing. In these the rolls are of wood and the pressure of the rolls alone does the work giving the clothes the same smooth appearance as if hot ironed. In Pennsylvania they are made alone of sugar maple but the Michigan report also shows beech and elm though in much smaller quantities. Machines are also made for hot ironing and in these the upper roll is hollow metal heated while the lower one is wood covered with padding and a top dress of muslin. Mangle rollers vary in size from 3½ inches in diameter and 20 inches long to 6 inches diameter and 24 inches long.

Washing machines are of various designs and shapes, some in box form, some conical shape similar to a wash tub, and others are cylindrical. The last named is the design used in steam laundries. Cypress is more suitable than any other wood for washing machine bodies because it is less liable to warp and more durable in situations of alternating moisture and dryness. Ash and to a small extent white pine were also reported. Of the Pacific coast woods, redwood seems to give the best result. On account of the strength of sugar maple it was called on for the legs of washing machines; and beaters or agitators which work inside of the machine to turn the clothes in washing are made of beech or maple.

The reasons which commend cypress for washing machines make it the principal wood for wash tubs In Michigan spruce was the favorite wood while the Illinois manufacturers used cypress, cotton gum, and red gum in the order named. The increasing use of these woods, especially cotton gum, which is tupelo, is worthy of note.

For washboards, the manufacturers require woods that are light in color, especially for the print board, which is stenciled. Yellow poplar alone is called on in this State but in Ohio, Illinois, and Michigan, basswood, cottonwood, and cotton gum were demanded. Washboard sides or posts are made from beech and sugar maple. The former is more extensively used. The rubbing surface at one time was made of maple and beech, but now metal or glass rubs have been substituted.

Table 60.—Wood for Laundry Appliances, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Sugar maple,	6,340,500	58.73	$23 75	$150,613	3,385,500	2,955,000
Beech,	1,432,000	13.26	15 95	22,842	1,352,000	80,000
Birch,	1,090,000	10.10	12 72	13,860	1,070,000	20,000
Yellow poplar,	610,000	5.65	16 44	10,030	500,000	110,000
Cottonwood,	500,000	4.63	32 90	16,450	....	500,000
Basswood,	437,000	4.05	32 52	14,210	108,500	328,500
Yellow buckeye,	125,000	1.16	28 00	3,500	125,000	....
Red and silver maple,	80,000	.74	25 00	1,990	42,500	37,500
White pine,	78,200	.72	35 92	2,809	25,000	53,200
Cypress (bald),	39,000	.36	39 10	1,525	....	39,000
White oak,	30,000	.28	23 50	705	10,000	20,000
Red oak,	30,000	.28	23 50	705	10,000	20,000
Chestnut,	3,000	.03	24 00	72	2,000	1,000
Ash,	1,000	.01	25 00	25	1,000	....
Total,	10,795,700	100.00	$22 17	$239,336	6,631,500	4,164,200

CIGAR BOXES.

Cigar boxes are the only wooden tobacco containers made in Pennsylvania and the woods required solely for this purpose are listed in Table 61. In a number of southern states, plug and twist tobacco boxes were included with cigar box lumber and the factories known as the tobacco box industry. Cigar box material is bought as thin lumber and veneer, the former usually 5-32 of an inch in thickness. This material, as is customary in commerce, was reported in terms of superficial feet. To make it comparable with the other tables of this report, however, it was reduced to board measure and valued on that basis. For this reason the cost of the material may appear somewhat high, especially since the cost of manufacture has not been eliminated nor has any allowance been made for waste. The prices range from $20 to $30 per thousand feet surface measure for Spanish cedar, $12.50 to $16.50 for yellow poplar and basswood and $14 to $17.50 for cotton gum and red gum.

Though the eastern part of Pennsylvania raises the best grades of leaf tobacco, the center of the cigar box industry is not located there but in the Pittsburgh region where the manufacture of stogies and cigars has gained a reputation.

Spanish cedar, it is claimed, gives a delicate odor to the cigars which is attributed to no other wood. This accounts for the fact that it is the principal cigar box wood not only in Pennsylvania but in the country at large. Spanish cedar is native to the West Indies and Central America and is brought to this country in log form to be manufactured. It is a broad leafed tree and not a relative of the domestic cedars or junipers which are conifers.

Not all of the Spanish cedar goes into cigar boxes as thin lumber. Much of it is veneer glued to a native wood that is thicker and this two-ply stock supplies a large part of the demand of the cigar box material and at a price considerably below that asked for Spanish cedar lumber. Yellow poplar, cotton gum, basswood, and red gum are the domestic woods which furnish most of the veneer backing. Yellow poplar is used in larger quantities in Pennsylvania than the combined amounts of the three other woods, probably because western Pennsylvania is near to the center of the yellow poplar lumber producing region. This region, together with a part of Pennsylvania, includes mainly West Virginia, eastern Kentucky, Tennessee, and southern Ohio. Tupelo or cotton gum and red gum are equally well suited for built-up material. They work easily and with the recent improvement in kiln drying veneer the objection formerly made to their tendency to twist and warp has been largely overcome. The decreasing supply of yellow poplar and its large demand for many other uses are bringing cotton and red gum rapidly to the front for this line of manufacture.

The domestic woods used are not all overlaid with Spanish cedar veneer. They are extensively cut to full thickness for boxes of solid lumber. To give these woods a cigar box appearance, which means to make it resemble Spanish cedar, the process of stamping is resorted to and improvements in this line give it an effect which makes it difficult without close inspection to distinguish the imitations from the cedar. Where domestic woods are independently used, most often the inside of the box is covered with litho paper, advertising the name of the cigar and maker. Waste in cigar box manufacture is largely utilized; the ends and sides can be made from what is left after cutting the tops and bottoms.

Table 61.—Wood for Cigar Boxes, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Spanish cedar,	5,800,160	58.41	$112 71	$653,735	....	5,800,160
Cotton gum,	2,043,917	20.58	63 37	129,519	....	2,043,917
Yellow poplar,	1,041,928	10.49	75 31	78,465	24,500	1,017,428
Red gum,	549,750	5.54	49 79	27,373	....	549,750
Basswood,	495,000	4.98	64.95	32,150	....	495,000
Total,	9,930,755	100.00	$92 77	$921,242	24,500	9,906,255

WOODENWARE AND NOVELTIES.

The commodities produced by the factories grouped under this industry are many and varied. This accounts for the twenty different woods listed in Table 62, including small quantities of two foreign woods, rosewood and lignum-vitae. The total consumption of wood in this industry was over eight and one-half million feet annually and beech, mostly home-grown, was used in quantities greater than the total of any other five woods listed. Basswood represented the greatest amount of shipped-in material, a little over three-fourths of it coming from New York and West Virginia.

Woodenware refers to useful household articles, such as pails, buckets, freezers, hose reels, snow shovels, rat and mouse traps, comb boxes, broom holders, and towel racks, and also to utensils important in the equipment of kitchens, such as pastry and pie boards, meat boards, rolling pins, slaw cutters, fish and steak planks, lemon squeezers, potato mashers, etc. A portion of the pails made by this industry in Pennsylvania is for candy packages. Though these may more properly belong to the box industry, they have been included here with other pails and buckets, the method of manufacture being identical and the same factories making both styles. While white pine is the favorite wood for pail staves in Pennsylvania, as it is in nearly all other states where this industry is important, a few of the softer hardwoods like basswood, yellow poplar, buckeye, and willow are also employed. Bales or handles of buckets are rarely made by the pail manufacturer. The variety wood-workers or manufacturers specializing in all kinds of turnings furnish them. Beech, birch, and maple are used in the largest quantities.

Mouse traps belong to this industry. They are made of beech, yellow poplar, red gum, sugar maple, and white elm in the order named, and over 1,500,000 feet of these woods are annually required for their making. Sugar maple and holly were used for rolling pins, the latter being shipped from Arkansas and being desired because of its density, toughness, whitish color, and its capacity to turn well. Beech being strong and not imparting a taste went for lemon squeezers except for the bowls which required a harder, denser wood. Lignum-vitae, sent in from the West Indies, was found most suitable and is used for expensive squeezers while glass bowls answered for cheaper ones.

Planks for cooking planked fish and steaks have been made for years from one wood, principally white oak. Originally a common surfaced oak board met the demand but now they are manufactured in various shapes and sizes to fit the holders into which they are placed for service. To keep the essences from running off the plank they are frequently grooved which adds also to their appearance when not in use. Rosewood was the only foreign wood reported for toddy sticks but sugar maple and beech are most commonly used.

Novelties are of so many different kinds that space here will not allow an attempt to name them. Novelty makers themselves can hardly list all the different articles they make because they produce specialties of all kinds, mostly to order, and usually have no standard lines. Those marked with an * in the legend of the accompanying illustration will give an idea of the class of commodities included as novelties.

Table 62.—Wood for Woodenware and Novelties, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Beech,	3,639,000	42.44	$20 46	$74,446	3,356,000	283,000
Sugar maple,	1,040,500	12.13	23 34	24,280	737,500	303,000
Basswood,	944,000	11.01	24 26	22,905	228,500	715,500
Ash,	634,500	7.40	30 67	19,462	259,500	375,000
White elm,	500,000	5.83	28 00	14,000	....	500,000

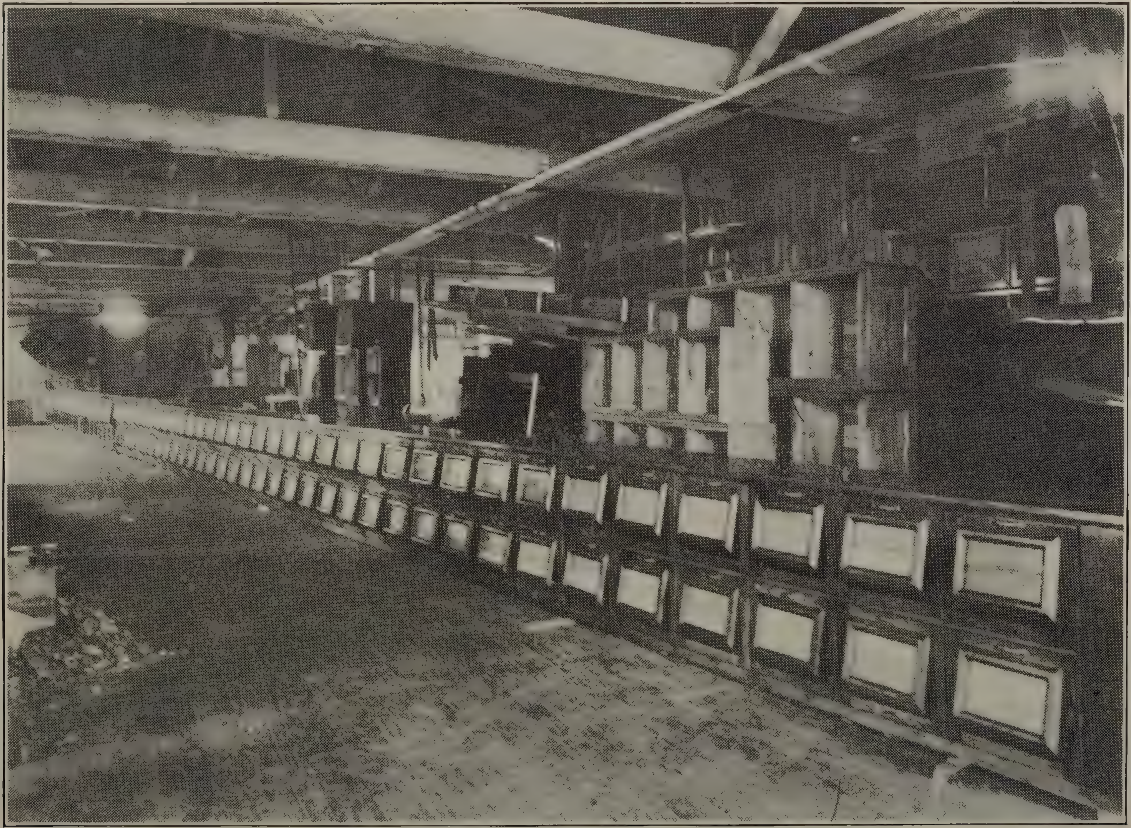

Fig. 16.—Tier bins for a provision store, just completed by a fixture manufacturer of Pittsburgh.

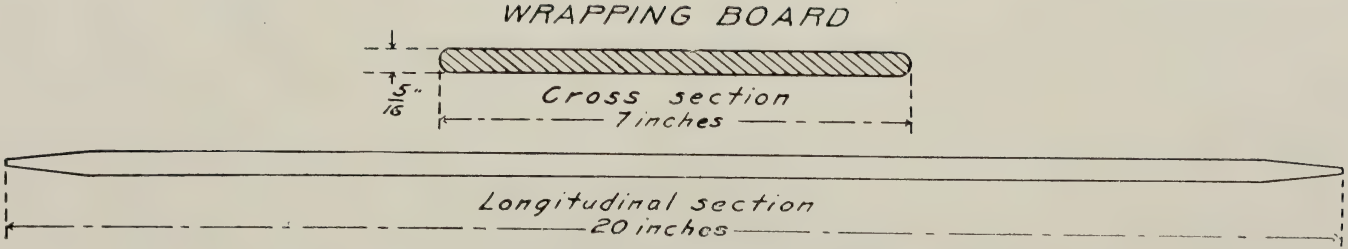

Fig. 17.—Drawing showing standard dimensions of a wrapping board.

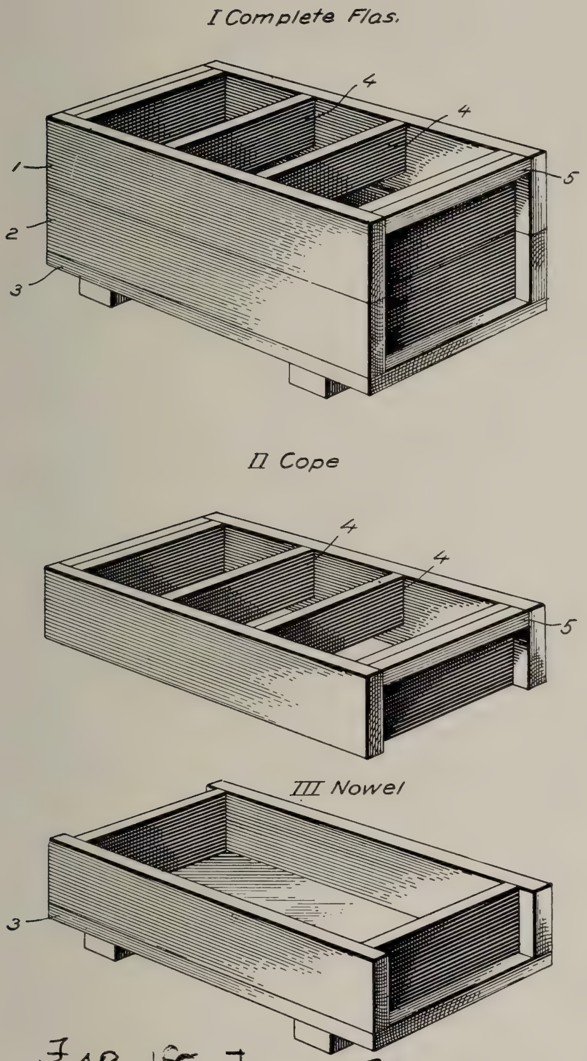

Fig. 18 – Foundry Flasks

Fig. I -I. Cope
2 Nowel
3. Bottom board
4. Cope bars
5. Handles

Fig. II - 4. Cope bars
5. Handles

Fig. III - 3 Bottom board

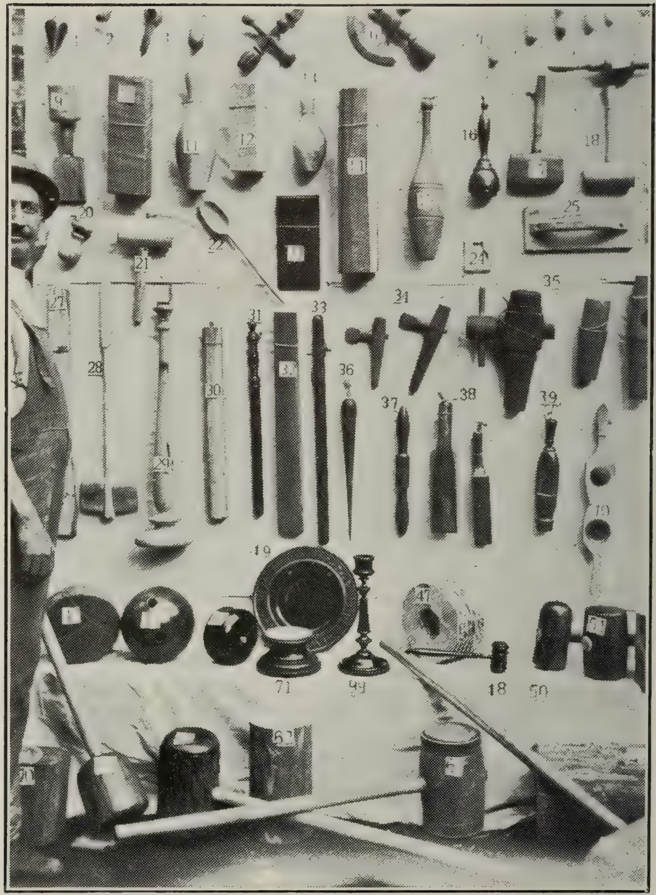

Fig. 19.—Sixty different kinds of novelties made by one manufacturer of Pennsylvania.

DESCRIPTION OF FIGURE 19.

*1. Plumber's turnpin—dogwood.
2. File handle—black walnut.
3. Candlestick—soft maple.
4. Drift plug (plumber's)—dogwood.
*5. Banner pole emblem—yellow poplar.
*6. Banner pole emblem—yellow poplar.
7. Turned handles, bench tools—sugar maple.
8. Rolling pin—sugar maple.
9. Bench rammer, foundry tool, made from 10.
10. Rough square—sugar maple.
11. Ten pin, made from 10.
13. Duck pin, made from 12.
15. Indian club made from 14 (rough square)—yellow poplar.
*16. Gavel—rosewood.
17. Tinner's mallet—lignum-vitae.
18. Carpenter's mallet—dogwood, maple handle.
19. Dental mallet—dogwood.
*20. Flag pole top—sugar maple.
21. Foundry mallet—dogwood, maple handle.
22. Spoons—soft maple.
*23. Baseboard, mounting used by taxidermist—red oak.
*24. Watch case frame—yellow poplar.
25. Plasterer's houck—sugar maple.
28. Bung starter, made from rough square 27—dogwood.
*29. Candle pedestal—yellow poplar.
*31. Policeman's club—rosewood, made from rough square 30.
*33. Watchman's billy—mahogany, made from rough square 32.
34. Spigots—red cedar.
35. Spigot, oil barrels—red cedar, two unfinished parts.
*36. Fid (rope slicer)—hickory.
37. Air pump handle—hickory.
38. Large and small plumber's dressers—lignum-vitae.
39. Bottle corker—sugar maple.
*40. Lemon squeezer—sugar maple with cup and filler—lignum vitae.
42. Bolt—lignum-vitae.
45. Ten pin ball made from 42.
*46. Bull's eye used as a rope tie on ships—lignum vitae.
47. Electrical apparatus part, 9 layers glued—mahogany.
*48. Gavel—ebony.
*49. Alms plate—black walnut.
50, 51 and 52. Coopersmith's mallet—dogwood and water gum, hickory handle.
57. Bolt—water gum.
60. Maul—hickory, handle made from 57.
61. Maul—hickory, handle made from 62.
62. Bolt—water gum.
67. Maul—hickory, handle with bark made from 62.
68. Kraut stamper—sugar maple, handle made from 70.
70. Bolt—water gum.
*71. Pedestal for loving cup—red gum.
*98. Candlestick—mahogany.

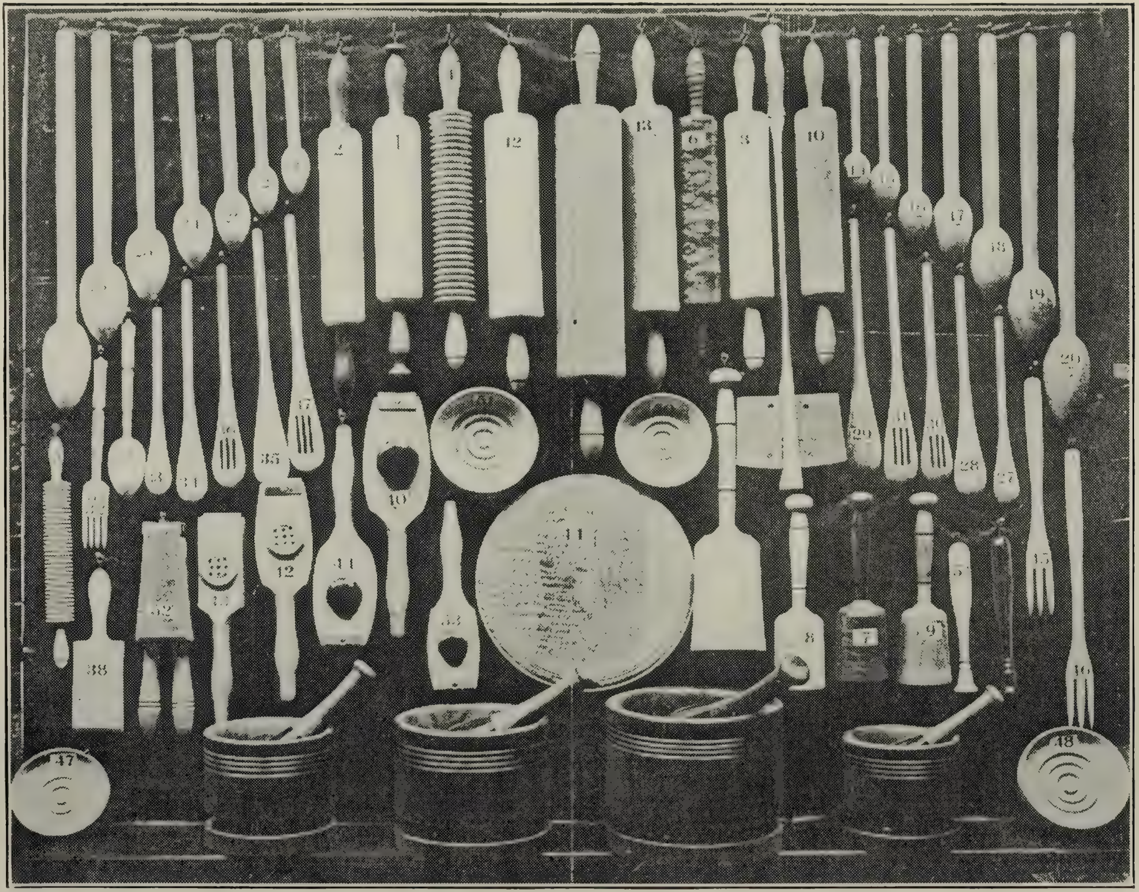

Fig. 20.—Product of a woodenware manufacturer of Philadelphia.

Table 62—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Yellow poplar,	482,500	5.63	29 11	14,045	27,500	455,000
Birch,	466,500	5.44	25 95	12,105	230,000	236,500
Red gum,	225,000	2.62	23 50	5,287	....	225,000
White pine,	225,000	2.62	11 78	2,650	225,000	....
Red and silver maple,	210,525	2.45	14 43	3,038	210,525	....
Yellow buckeye,	83,700	.98	25 00	2,092	....	83,700
Holly (American),	60,000	.70	100 00	6,000	....	60,000
White oak,	26,300	.31	31 64	832	25,800	500
Willow,	25,000	.29	13 00	325	25,000	....
Cotton gum,	6,900	.08	20 00	138	....	6,900
Hickory,	2,500	.03	60 00	150	2,500	....
Spruce,	1,000	.01	43 00	43	....	1,000
Red oak,	800	.01	40 00	32	800	....
Rosewood,	555	.01	245 05	136	....	555
Lignum-vitae,	500	.01	350 00	175	....	500
Total,	8,574,780	100.00	$23 57	$202,141	5,328,625	3,246,155

TANKS, VATS, AND SILOS.

The market for wooden tanks is broadening in spite of the fact that metal tanks are used to a considerable extent. In no other line is there a greater increase in demand for this commodity than by factories where tanks are needed to furnish water for manufacturing and engineering purposes. They are usually elevated to the top of the factory buildings, but most frequently on towers varying in height according to the pressure desired. Water tanks along railroads are in this class and southern white cedar, cypress, white pine, and longleaf pine, in the order of quantity, are the woods used for the staves. Shortleaf pine and hemlock went for tank covers. Tank staves are made of heavy material, the thickness varying according to the size and use of the tanks. Often the staves are as much as three inches thick and they must of necessity be made of the best grade of lumber since tanks are subject to strong pressure besides continued atmospheric changes, and the influence of water and other liquids has a deteriorating effect.

In selecting material for tank and vat staves the manufacturer is guided mainly by the use to which the finished commodity is to be put, as there are qualities in the several woods which commend them for certain kinds. The distillers and vinegar makers prefer yellow poplar for keeping-vats, but yellow poplar in some localities is too costly and its place has been taken by cypress and white pine. Brewery vats are usually of cypress and white oak. These woods are durable and strong and have no effects upon the taste and odor of the contents. Where a tank is closed and fermentation active or where one of extra resisting power is needed, white oak is preferred because close grained, heavy, and strong. Southern white cedar is also a favorite and though not so strong as white oak, when used it is strongly reinforced.

Vats for the manufacture of oleomargarine are of white pine, cypress, and Douglas fir, while those in pickle factories are generally cypress, Douglas fir, and longleaf pine. Individual oil tanks call for white pine, white oak, and chestnut. The use of the last named wood is interesting since Pennsylvania is the only state in which this wood has been reported for tank staves. It may be in the future that it will be called on more generally for this use owing to its being cheaper than most other tank woods and being sufficiently strong and durable. The tanners are not particular as to the kinds of woods used for their tanks, durability and strength being the principal considerations. Cypress and southern white cedar were the most prominent, the latter because of durability being the best qualified.

The silo is given a place in this industry because generally it resembles a tank both when built and in its component parts and occasionally makers of tank stock also manufacture silos. The processes of manufacture of both, though not identical, are similar. The up-to-date farmer regards the silo as an almost indispensable part of his equipment as it furnishes a means of having succulent forage during the winter season. The demand for silos is growing rapidly and large quantities of high grade lumber go for their making. Longleaf pine, Douglas fir, cypress, red or Norway pine, and white pine are the silo woods the Pennsylvania manufacturers report. White pine is probably the best known, as it has been used longer than any other and is the only home grown pine reported. Its high price probably accounts for its use only in small quantities. Because cypress is durable in damp situations, it is regarded one of the best silo materials and in some localities is preferred even above white pine. Next to southern white cedar it will outlast any other wood for silos. Longleaf pine from the South and Douglas fir from Idaho and Oregon are extensively used and are favored because staves can be made from them in sufficient lengths for one piece staves. Silos of this character are more easily erected than when the staves are in two or three pieces. These woods do not twist or warp; they are close-grained, strong, unaffected by acids or juices of the plants and are cheaper. Redwood is meeting a growing demand for staves according to silo makers in other states but none was used in Pennsylvania. It is claimed that redwood, next to cypress, is the most durable wood, can be gotten in long lengths, is free from sap and knots, is not given to check and warp, and will answer both for silos in exposed situations as well as for those built into barns.

Table 63.—Wood for Tanks and Silos, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Longleaf pine,	2,565,000	32.66	$26 57	$68,150	....	2,565,000
Southern white cedar,	2,554,000	32.52	36 31	92,740	....	2,554,000
Cypress (bald),	1,138,000	14.49	56 32	64,090	....	1,138,000
White pine,	820,000	10.44	34 84	28,570	60,000	760,000
Douglas fir,	450,000	5.73	43 33	19,500	....	450,000
Spruce,	100,000	1.27	30 00	3,000	....	100,000
Shortleaf pine,	86,200	1.10	29 47	2,540	....	86,200
White oak,	50,000	.64	43 00	2,150	50,000	....
Norway pine,	50,000	.64	35 00	1,750	....	50,000
Hemlock,	25,000	.32	18 00	450	25,000	....
Chestnut,	15,000	.19	20 00	300	15,000	....
Total.	7,853,200	100.00	$36 07	$283,240	150,000	7,703,200

MACHINE CONSTRUCTION.

Most parts of the machinery equipment of paper mills, flour mills, ice factories, sawmills, cotton gins, etc., are made of iron and steel, but for others wood is required and it is the different kinds of lumber for making these parts that are listed in Table 64. Electrical machinery parts and other electrical apparatus are not included in this class. This information will be presented subsequently as a separate industry. It is natural to infer that wooden parts of machinery must, in a great number of cases, call for lumber of great strength. It is not surprising, therefore, to find that white oak is the preponderant wood, comprising over one-third of the total and that longleaf pine and hickory follow it in quantity. The largest amount of hickory in the form of plank is shown in this industry. The vehicle and handle makers report using more but their raw material is in billet form, in squares, and in bolts. Douglas fir is the only Pacific coast wood listed. Like longleaf pine it possesses considerable strength and because the trees grow large and of great height, timber of large dimensions and length can readily be obtained. This probably accounts for its appearance in this industry, far from where it is cut. The average price is nearly twice that of longleaf pine.

Machine parts must necessarily be made from high grade lumber and in this connection it is interesting to note that nearly 55 per cent. of all that was reported was grown in the State. The factories included in this industry are numerous, though compared with other industries they use small amounts of wood. The fact that the requirements of these manufacturers are met so largely by the forests of the State should elicit their interest in the movement to protect forests and thereby perpetuate the State's timber supply. Some parts of 14 of the 19 woods listed in the table were cut in Pennsylvania, and their principal uses have been arranged in the order of their importance as follows:

Bins (Road Equipment).
Shortleaf pine.

Breaker.
Yellow poplar.

Cider Mills.
Yellow poplar.

Clay Working Machinery.
Hemlock.

Cranes.
Yellow poplar.

Coal Mining Machinery.
White oak.
Hickory.
White ash.
Shortleaf pine.
Maple.
Birch.
Basswood.
Yellow poplar.
Chestnut.
Hemlock.

Derricks.
White oak.
Cork elm.
Sugar maple.
Douglas fir.

Elevators.
Red oak.
Chestnut.
Longleaf pine.
Yellow poplar, (feed mills).
Basswood.
White oak.

Engine and Machinery Skids.
Beech.
Sugar maple.
Hemlock.
Hickory.

Flour and Feed Mill Machinery.
Red oak.
Yellow poplar.
Longleaf pine.
Sugar maple.
Hickory.
Chestnut.
White ash.
White pine.

General Mill Machinery.
White pine.
Longleaf pine.
Sugar maple.
White oak.
Cypress.

Hoists.
Yellow poplar.
Sugar maple.
Hickory.

Horse Power Machinery.
Sugar maple.
Yellow poplar.

Ice Machines.
White oak.
Red oak.
Longleaf pine.
White ash.

Oil Well Machinery.
White oak.
Red oak.
White pine.
Shortleaf pine.
Hemlock.
Sugar maple.
Beech.
Douglas fir.
Longleaf pine.

Ore Machinery.
Red oak.
Chestnut.

Paper Mill Machinery.
White oak.
Yellow poplar.
Longleaf pine.
Sugar maple.

Push Poles.
Hickory.
Ash.

Road Scrapers.
Longleaf pine.
White pine.

Road Engine Parts.
Yellow poplar.
Red oak.
White oak.
White pine.

Rock and Stone Crushers.
Red oak.
Chestnut.
White oak.
White pine.

Sawmill Parts.
Longleaf pine.
Hickory.
Red oak.
White oak.
Shortleaf pine.

Mining Screens.
Red oak.
Chestnut.

Water Wheels.
White oak.
White pine.
Shortleaf pine.
Poplar.

Table 64.—Wood for Machine Construction Parts, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White oak,	2,366,100	33.61	$26 31	$62,258	2,311,100	55,000
Longleaf pine,	1,431,000	20.33	27 66	39,585	....	1,431,000
Hickory,	699,000	9.93	27 27	19,063	643,000	56,000
Yellow poplar,	640,800	9.10	42 86	27,463	29,800	611,000
Red oak,	557,500	7.92	27 79	15,491	247,500	310,000
Hemlock,	296,000	4.20	18 22	5,392	296,000	....
Sugar maple,	288,700	4.10	29 69	8,572	145,700	143,000
Douglas fir,	200,000	2.84	51 25	10,250	....	200,000
Shortleaf pine,	163,000	2.31	23 99	3,910	10,000	153,000
White pine,	143,500	2.04	41 34	5,932	83,500	60,000
Ash,	83,000	1.18	44 88	3,725	5,000	78,000
Chestnut,	73,000	1.04	35 67	2,604	23,000	50,000
Pitch pine,	49,100	.70	16 44	807	49,100	....
Loblolly pine,	25,000	.35	32 00	800	....	25,000
Beech,	11,000	.16	14 55	160	11,000	....

Table 64—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Basswood,	8,500	.12	36 47	310	500	8,000
Birch,	3,000	.04	25 00	75	3,000	....
Cork elm,	2,000	.03	50 00	100	....	2,000
Cypress (bald),	150	*	75 00	11	....	150
Total,	7,040,350	100.00	$29 33	$206,508	3,858,200	3,182,150

*Less than 1-100 of 1 per cent.

AGRICULTURAL IMPLEMENTS.

All commodities used by farmers in the preparation of the soil and in gathering and garnering crops are grouped under this industry. The principal uses of the eighteen woods called for are as follows:

Cider Mill Presses.
- Sugar maple.
- White pine.

Cultivator Parts.
- Ash (handles, pole).
- Shortleaf pine.
- White oak (handles).

Corn Planter Parts.
- Basswood.
- Yellow poplar.

Corn Sheller Parts.
- Beech (frames).
- Birch (frames).
- Chestnut.
- Shortleaf pine (sides).
- Sugar maple (boxes, posts).

Eveners.
- Hickory.
- Red oak.
- White oak.

Feed and Ensilage Cutter Parts.
- Beech (frame work).
- Cypress (boxes).
- Shortleaf pine (box sides).
- Yellow poplar (sides).

Fertilizer and Lime Distributors.
- Cotton gum (boxes).
- Longleaf pine (poles).
- Red gum.

Hand Rakes.
- Hickory (teeth).

Harrows, Spike Tooth.
- Red oak.
- White oak.

Hay Ladders.
- Ash.
- White oak.

Hay Presses.
- Sugar maple.
- White oak.

Horse Pokes.
- White elm.

Horse Rake Parts.
- White ash.

Land Roller Parts.
- Longleaf pine (poles, tops).
- Shortleaf pine (tops).
- Sugar maple (blocks, tongues, tops).
- White oak (frames).

Lawn Mower Handles.
- Black ash.
- White ash.

Levers, Various Implements.
- White ash.

Fertilizer Distributor Parts.
- Red gum.

Litter and Straw Carrier Parts.
Sugar maple.
White oak.
Yellow poplar.

Neck Yokes.
Hickory.
White oak.
Beech.

Threshing machines, including grain threshers and clover hullers, are the most important commodities of this industry, and in this particular line of manufacture Pennsylvania leads all other states. There are many interior parts of these machines that require woods of different qualities. The general tendency to substitute metal for wood has not proved practical and consequently a majority of these parts like grain registers, dust conveyors, and screen frames are still made largely of wood. Likely for the same reason, frames and siding or exterior panels of threshers call for wood and white pine and yellow poplar are the principal panel woods because these woods are light, easily worked, take paint readily, and are not given to twist and check.

Straw-carriers, closely allied to threshers, are another product important in this industry in Pennsylvania. Woods similar to those for threshers are demanded; white oak, yellow poplar, and sugar maple in the order named being most frequently called for.

Corn shellers and land rollers demand a considerable amount of lumber each year. Beech for framing, shortleaf pine, and yellow poplar for panels play an important part in making the former, and sugar maple and oak for the latter. The rollers of land rollers were formerly made of wood. A cross-section from a sycamore or yellow poplar log was usually selected and the rollers were usually made on the farm or at nearby blacksmith shops. Today these implements are in universal use and have been found indispensable, as a labor saver. The factories sometime ago began making them and now use metal almost entirely, but a small amount of wood is still in use and hard maple meets the demand in the State. The bottoms of the roller platforms are of shortleaf pine but any strong wood will answer for this purpose. The roller blocks or bearing frames are of hard maple. The hay baler manufacturers also use sugar maple ahead of other woods; but oak, both white and red, is indispensable for certain parts.

Table 65.—Wood for Agricultural Implements, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White oak,	1,678,700	23.97	$35 60	$59,768	887,700	791,000
Red oak,	1,617,000	23.08	32 58	52,680	447,000	1,170,000
Sugar maple,	1,032,600	14.74	28 04	28,952	365,500	667,100
Yellow poplar,	757,500	10.81	34 59	26,205	33,000	724,500
Ash,	599,100	8.55	38 73	23,202	103,100	496,000
Longleaf pine,	563,200	8.04	31 77	17,893	......	563,200
Chestnut,	140,000	2.00	19 07	2,670	40,000	100,000
Hickory,	124,400	1.78	33 41	4,156	99,400	25,000
White pine,	116,000	1.66	31 71	3,678	26,000	90,000
Shortleaf pine,	95,000	1.36	29 74	2,825	......	95,000

Table 65—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Basswood,	80,000	1.14	31 06	2,485	30,000	50,000
Cork elm,	50,000	.71	25 00	1,250	50,000	......
Beech,	42,000	.60	22 86	960	32,000	10,000
Cotton gum,	35,000	.50	36 00	1,260	......	35,000
Cypress (bald),	30,000	.43	35 00	1,050	......	30,000
Red gum,	24,000	.34	36 00	864	......	24,000
Birch,	20,000	.29	24 00	480	20,000	......
Cucumber,	300	*	30 00	9	300	......
Total,	7,004,800	100.00	$32 89	$230,387	2,134,000	4,870,800

*Less than 1-100 of 1 per cent.

TOYS.

The commodities included in this industry and the woods that supplied the material for making them are as follows:

Animals.
Basswood.

Blocks (Toy Wagon).
White pine.

Boats.
Basswood.
White pine.

Cannon and Fort Sets.
Basswood.
Sweet birch.
Beech.

Chairs (Children's).
Hard maple.
Beech.

Chairs.
Birch.

Circus Sets.
Basswood.
White pine.
Yellow poplar.
Sweet birch.
Beech.

Dolls.
Basswood.

Furniture.
White pine.
Beech.
Yellow poplar.
Chestnut.
Birch.
Soft maple.
Sugar maple.
White oak.
Red oak.
Elm.

Games.
White ash.
White oak.
Yellow poplar.
Basswood.

Holders (Christmas Tree).
Yellow poplar.

Jumpers (Swing).
Red gum.

Pianos (Children's).
Basswood.

Pastry Sets.
White elm.
Red oak.
White oak.

Play Yards (Baby).
White oak.
Red oak.

Shooting Galleries.
White pine.
Beech.
Sweet birch.
Basswood.

Rockers.
White oak.
Red oak.

Tricycle Seats.
Yellow poplar.
Basswood.

Stick Horses.
Heads.
White pine.
Yellow poplar.

Sticks.
Basswood.
White pine.

Wheels.
Beech.
Sweet birch.

Stocks, Pop Gun.
Basswood.
Beech,
Sugar maple.

Swings.
Red oak.
Sugar maple.

Walkers.
Hard maple.
Yellow poplar.
Red gum.
Beech.

Rocking Horses.
White ash.

Toy Parts.
Basswood.
Beech.
Cotton gum.
Spruce.
Yellow poplar.
Hard maple.
Red oak.
White oak.

Wagons and Autos.
White pine.
Basswood.
Yellow poplar.

Tops.
Birch.
Beech.
Yellow poplar.
Chestnut.
Soft maple.
Sugar maple.
White oak.
Red oak.

Wheelbarrows.
White pine.
Basswood.
Yellow poplar.

Xylophones.
Sugar maple.
Rosewood.

Basswood is the principal material for wooden toys and for the wooden parts of metal toys. It is not only demanded in the greatest amount but it enters into the manufacture of more kinds than any other species. It alone supplied the material for the all-wood doll which is made in no other state. This doll is unique, ingenious, and wonderfully useful, in that nearly all parts,—body, arms, legs, hands, feet,—even the head—are made of solid wood. The face is artistically carved and when enameled in lifelike colors and the doll dressed, it is difficult to tell that it is made of wood. The parts of the body are jointed with steel bands having swivel connection, which gives flexibility and freedom of movement. The all-wood doll is made with facial characteristics representative of different nations and of comical characters.

The making of toy pianos is another important division of this industry. Basswood is the prevailing wood again and it goes into all the various parts except the base of large size pianos where a stronger wood is needed, and ash and oak meet this demand. Because it is easily bored and turned to shape, this wood answers first for toy cannons. It is also principally used for wooden animals in menageries and for horse heads and bodies for stick horses.

Though Pennsylvania was sixth in the list of states in the production of basswood lumber, the toy manufacturers reported purchasing 60 per cent. of their requirements from other states. Sugar maple, white pine, and yellow poplar were used not only in almost equal amounts but the average price paid for these woods was also nearly equal. That so much yellow poplar was State-grown is somewhat surprising. In no other industry of this report does wood, State-grown, equal so large a per cent. of the total. Nearly six and a half million feet was required and of this over 85 per cent. is cut in Pennsylvania.

Table 66.—Wood for Toys, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Basswood,	1,404,000	21.86	$40 80	$57,286	560,000	844,000
Sugar maple,	762,500	11.87	25 31	19,300	712,500	50,000
White pine,	725,000	11.29	24 90	18,050	487,500	237,500
Yellow poplar,	702,000	10.93	25 48	17,888	659,500	42,500
Beech,	627,400	9.77	18 41	11,553	585,000	42,400
Birch,	617,000	9.61	23 84	14,708	617,000	......
Chestnut,	500,000	7.79	21 00	10,500	500,000	......
Red and silver maple,	450,000	7.01	24 00	10,800	450,000	......
Ash,	320,000	4,98	42 03	13,450	182,500	137,500
White oak,	152,000	2.37	29 26	4,448	132,000	20,000
Red oak,	125,300	1.95	27 17	3,404	100,800	24,500
White elm,	25,000	.39	21 00	525	12,500	12,500
Cotton gum,	5,000	.08	20 00	100	......	5,000
Red gum,	5,000	.08	25 00	125	5,000	......
Spruce,	1,300	.02	43 00	56	......	1,300
Total,	6,421,500	100.00	$28 37	$182,193	5,004,300	1,417,200

TRUNKS AND VALISES.

Nine woods make up the four million feet of lumber required yearly in Pennsylvania for making trunks. A number of manufacturers do all the work from the arrival of the rough lumber to the covering, lining, and varnishing of the finished commodity, but others make only the rough boxes in the white, others slats, and others purchase the different parts already manufactured and merely put them together and finish them. The last named class of manufacturers did not make reports for this study because they do not operate wood-working machinery and are merely assemblers. The fact that white elm leads in quantity all other woods listed in the table indicates that in Pennsylvania the slat makers form the most important division of this industry. The quantity demanded, though fairly large, does not equal the amount of ash, which, next to elm, is generally the principal slat wood. Hickory is a frequently used slat wood on sample cases because of its strength but none of the trunk makers reported its use in Pennsylvania; its weight and its high price being against it.

Basswood is the favorite wood for trunk boxes and in Pennsylvania furnished about three-quarters of the material which the manufacturers used. It works easily and holds its shape. The fact that it is fairly strong for its weight qualifies it more than any other factor for this use. Cottonwood is its principal competitor and in the country at large is used in larger quantities. Like basswood it enters largely into veneer and then into built-up lumber from which the better grades of trunk boxes are largely made. Three and four-ply are the thicknesses principally used. Besides being of lighter weight than ordinary solid trunk box material it is also more substantial and, therefore, in most cases, does not require slat reinforcement. The trunk maker does not buy veneer and make panels. He buys panels already glued together in various thicknesses according to his varied needs. Red gum appears in the table in only small quantities. In other states the demand for it for trunks seems to be increasing and, like cottonwood, is purchased mostly in the form of built-up lumber.

White pine is a favorite wood for trunks made of solid lumber. It is purchased surfaced two sides and edged in thicknesses ranging from ⅜ inches to ⅞ inches according to the size and purpose for which the trunk is designed. In quantity the Pennsylvania trunk makers demanded white pine next to basswood. In the country at large loblolly pine is probably called on for solid trunk boxes ahead of any other wood. Lumber from second growth trees is preferred because of the large proportion of sapwood, its freedom from pitch, its light color and light weight. It goes for making the cheaper grades. As little of the wood is visible in the finished product, being covered with leather, cloth, and metal, the figure or color of the wood is not essential.

To save weight, a light wood, cut as thin as the maximum stress will allow, is demanded for trays and inside compartments. Basswood met the largest part of the demand in Pennsylvania while in other states yellow poplar, cotton gum, buckeye, and cottonwood were the species principally employed.

Table 67.—Wood for Trunks and Valises, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White elm,	1,837,500	44.57	$30 82	$56,625	250,000	1,587,500
Basswood,	1,374,500	33.34	27 80	38,209	754,500	620,000
White pine,	428,500	10.39	28 60	12,255	128,500	300,000
Cottonwood,	177,350	4.30	37 95	6,731	......	177,350
Loblolly pine,	160,000	3.88	24 22	3,875	......	160,000
Ash,	87,500	2.12	36 42	3,187	87,500	......
Chestnut,	37,500	.91	25 00	938	17,500	20,000
Red gum,	20,000	.49	35 00	700	......	20,000
Total,	4,122,850	100.00	$29 72	$122,520	1,238,000	2,884,850

BRUSHES.

Pennsylvania surpasses all other states in the production of brush blocks and for their manufacture the factories consume over four million feet of wood annually. Of this material the forests of the state furnished over 93 per cent. of the total, a fact which should appeal to this class of manufacturers when giving consideration to the source of future supply of raw material and what measures are to be taken when the present timber stand is gone. Each kind of the almost multitudinous variety of brushes that are manufactured requires a block of special size and shape, and a wood pos-

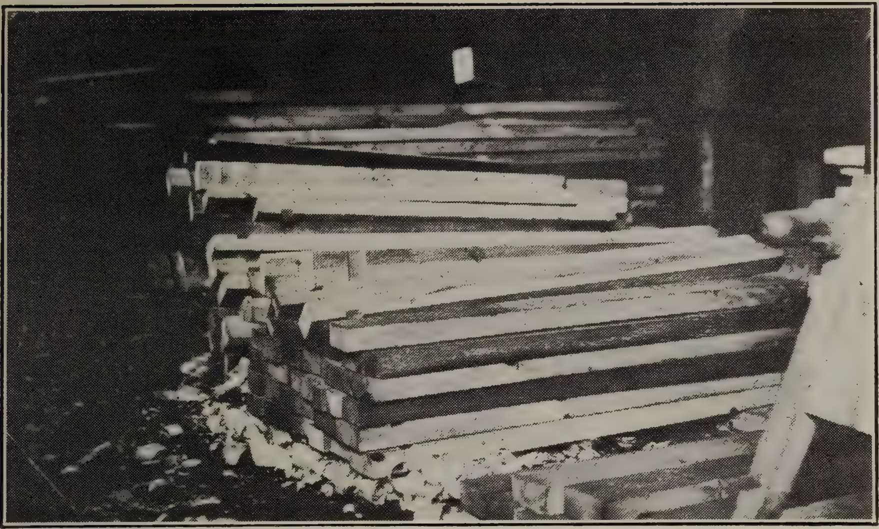

Fig. 21.—Oil tank staves preparatory to assembling.

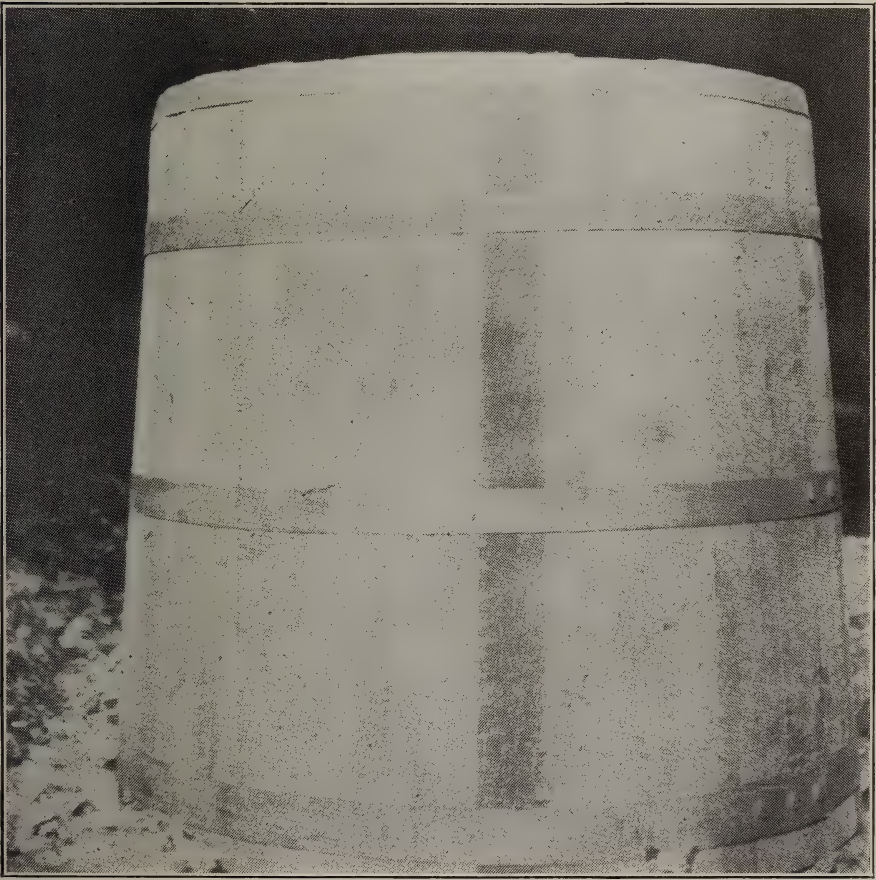

Fig. 22.—Finished oil tank.

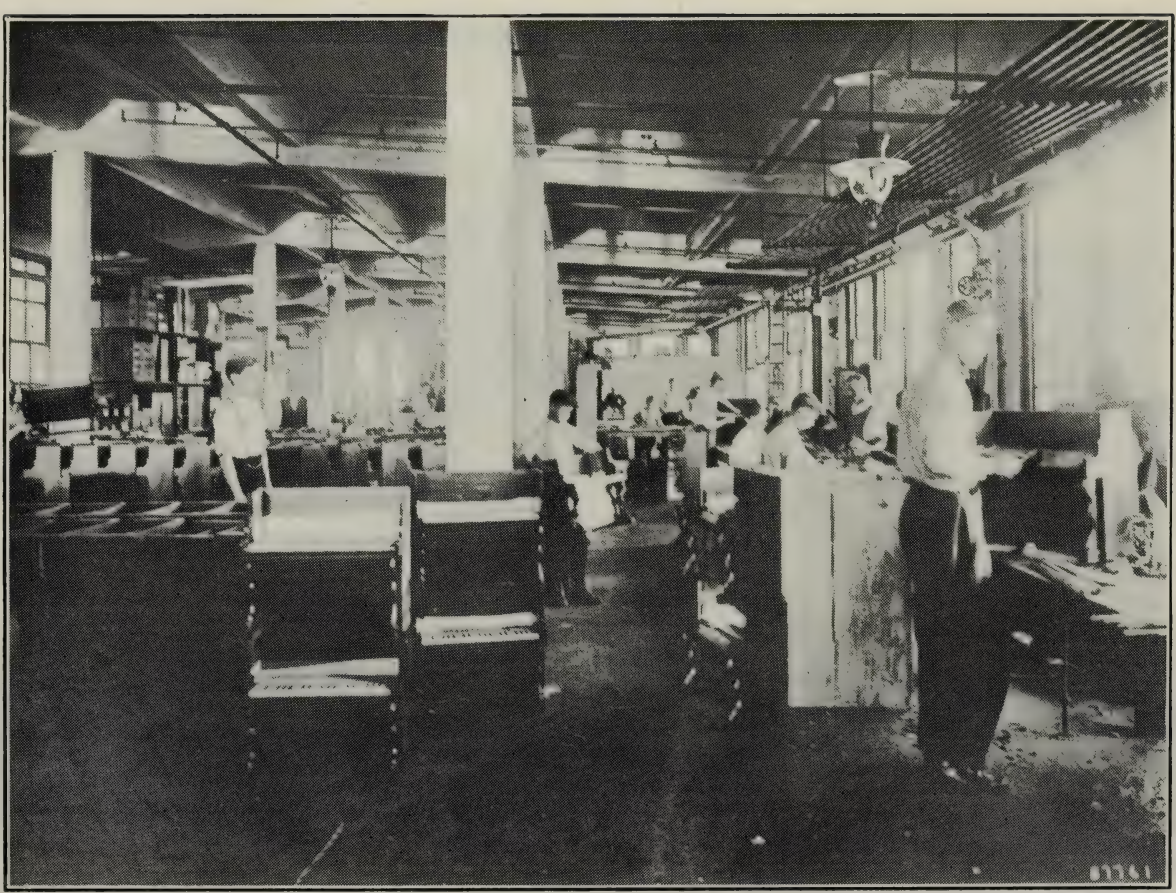

Fig. 23.—Manufacture of toy pianos.

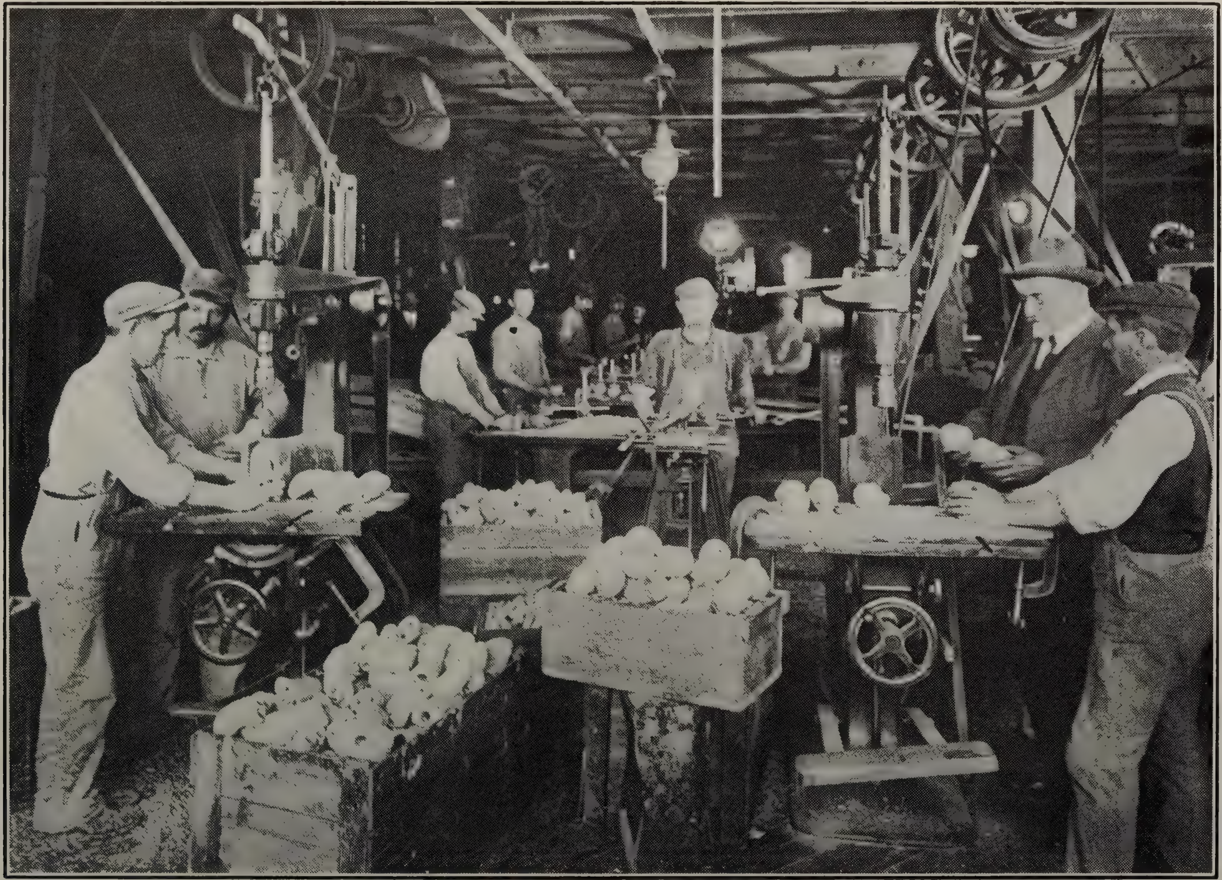

Fig. 24.—Woodworking department of a toy manufacturer. Making wooden dolls.

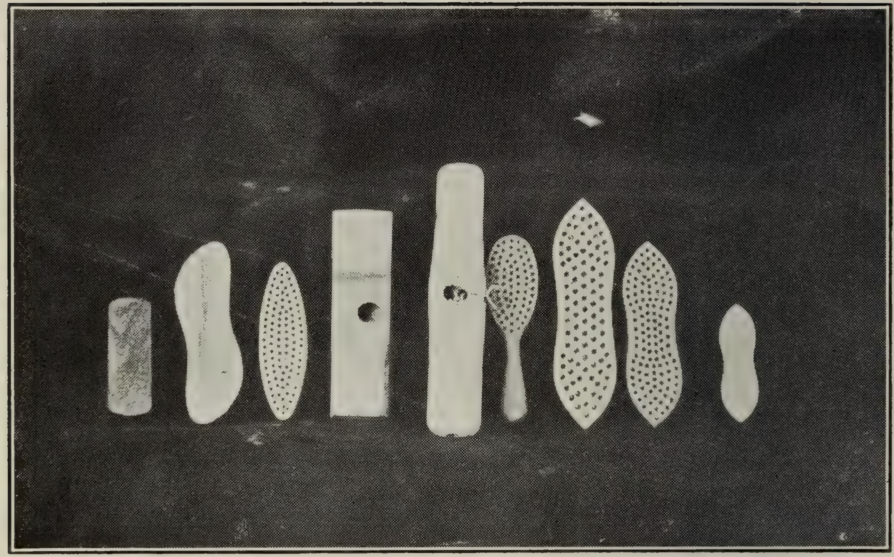

Fig. 25.—Brush Blocks.

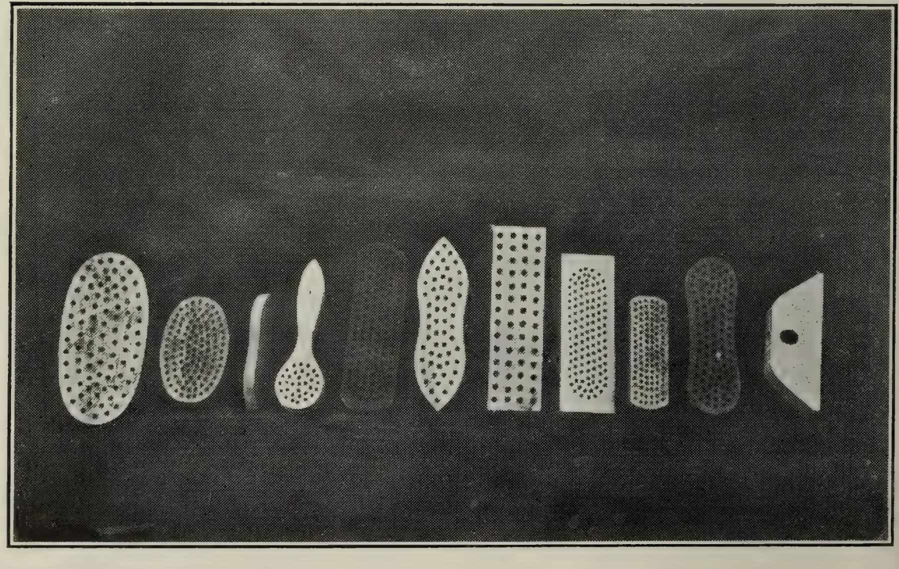

Fig. 26.—Brush Blocks.

sessing qualities adaptable to the special use of the brush. This accounts for the long list shown in the table. There are sixteen woods, and beech constitutes much the largest amount, being equal to almost half of the total. This wood is one of the most plentiful hardwoods growing in Pennsylvania, having properties admirably suited for cheap brushes, and is one of the factors making the industry important in the state. Maple furnishes material for brush blocks considerably more desirable than beech, and, therefore, is in demand for a better grade of brushes. It follows beech in importance as to quantity but of course is higher priced. In no other industry is cherry reported in so large amounts as for brushes. Its low average price as compared to that paid for the same wood by other classes of factories in the State is quite surprising. This industry does not include altogether the production of cheap brush blocks such as are used for making scrubbing, creamery, and brewery, sinks, dust pan, horse, feather dusters, window, stove, carpet, paint, whitewash, and frescoing brushes, and stable and street brooms, but it includes blocks for better grades requiring higher priced woods,—such as red cedar, ash, sycamore, holly, red oak, black walnut, rosewood, boxwood, and other foreign woods. The latter kinds are used for hair brushes, hat, jewelry, clothes, hand, nail, and flesh brushes. The absence of mahogany and ebony from the list of high grade brush woods is hard to explain but none of the manufacturers reported them in this State.

Table 68.—Wood for Brushes, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Beech,	1,931,000	47.83	$18 87	$36,430	1,931,000	......
Sugar maple,	1,066,800	26.43	23 22	24,772	1,066,800	......
Cherry (black),	482,900	11.96	25 43	12,282	482,900	......
Yellow poplar,	157,500	3.90	40 68	6,407	32,500	125,000
Red and silver maple,	156,000	3.86	18 96	2,957	136,000	20,000
Sycamore,	71,000	1.76	26 00	1,846	......	71,000
Birch,	51,000	1.26	14 02	715	51,000	......
Basswood,	42,300	1.05	34 96	1,479	42,300	......
Red gum,	37,000	.92	27 00	999	......	37,000
Red cedar,	23,000	.57	64 57	1,485	5,000	18,000
Ash,	12,600	.31	34 29	432	12,600	......
Boxwood (West Indian),	3,140	.08	51 91	163	......	3,140
Holly (American),	1,000	.02	45 00	45	......	1,000
Black walnut,	1,000	.02	80 00	80	1,000	......
Red oak,	600	.02	37 00	22	600	......
Rosewood,	250	.01	300 00	75	......	250
Total,	4,037,090	100.00	$22 34	$90,189	3,761,700	275,390

SHUTTLES, SPOOLS, AND BOBBINS.

The industry making bobbins, spools, shuttles and other loom appliances is in quantity not so large and important in Pennsylvania as in Maine, New York, and New Hampshire; but the fact that these commodities manufactured in Pennsylvania go almost entirely for use in silk mills, and only a few for woolen and cotton mills, is quite significant. Sugar and soft maple furnished the bobbin and speeder material, and for quills sugar maple and dogwood met the demand, the latter to only a limited extent on account of its higher price. Bobbin material must be hard, tough, close grained, with a texture that smooths easily, and must not rough up in turning.

Paper birch is the species from which small thread spools are manufactured and Maine is the state where most of them are produced. Small spools are turned from a single piece of wood but no factories in Pennsylvania were found making them. The manufacture of large spools, the three-pieced product, used in loom weaving, called for a considerable quantity of lumber. The barrels, sometimes called middles, are made by a process similar to that used in making bobbins and speeders and when in the rough-turned form resemble them except the barrels are uniformly cylindrical. Sugar and soft maple supplied the material for their making in Pennsylvania, but in New England beech and the birches were also used. The heads of these spools, which are cut circular, were entirely of yellow poplar and are screwed on and glued to the barrel, which is threaded at each end.

The most exacting demand for both dogwood and persimmon is for shuttle manufacture. These woods possess a hard dense fiber, wear smooth by use, do not rough up, and besides are heavy and strong. They are the favorite domestic woods for this purpose. Shuttles for silk weaving are made to only a limited extent of these woods. Foreign woods are also called on. Boxwood, both the kind that comes from the Caspian Sea countries and that shipped from the West Indies, was reported, and also small amounts of sarbo and doncella. They are the highest priced woods that are shown in the table. Formerly boxwood furnished nearly all the shuttle material but when its price became prohibitive dogwood took its place and proved a practical and satisfactory substitute. Persimmon has in comparatively recent years become prominent for shuttles, chiefly owing to the insufficient supply of dogwood to meet the entire demand. Shuttles are made from squares cut to the desired size called shuttle blocks and it is in this form that the manufacturers in Pennsylvania purchase their raw material. From the rough block to the finished shuttle there are twenty-two distinct operations.

White oak appears in this industry for making picker sticks and in no other state in which this article was reported was this wood used to any considerable extent. Hickory is the principal picker stick material and in Pennsylvania it supplied almost two-thirds of all wood demanded for this use. Quill boards are made entirely of yellow poplar and loom frames of sugar maple.

Table 69.—Shuttles, Spools, and Bobbins, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Sugar maple,	2,528,000	75.51	$24 85	$62,816	1,870,000	658,000
Red and silver maple,	375,000	11.20	26 43	9,910	40,000	335,000
Yellow poplar,	321,000	9.59	36 50	11,715	25,000	296,000
Hickory,	63,000	1.88	46 98	2,960	30,000	33,000
White oak,	35,000	1.05	50 00	1,750	5,000	30,000

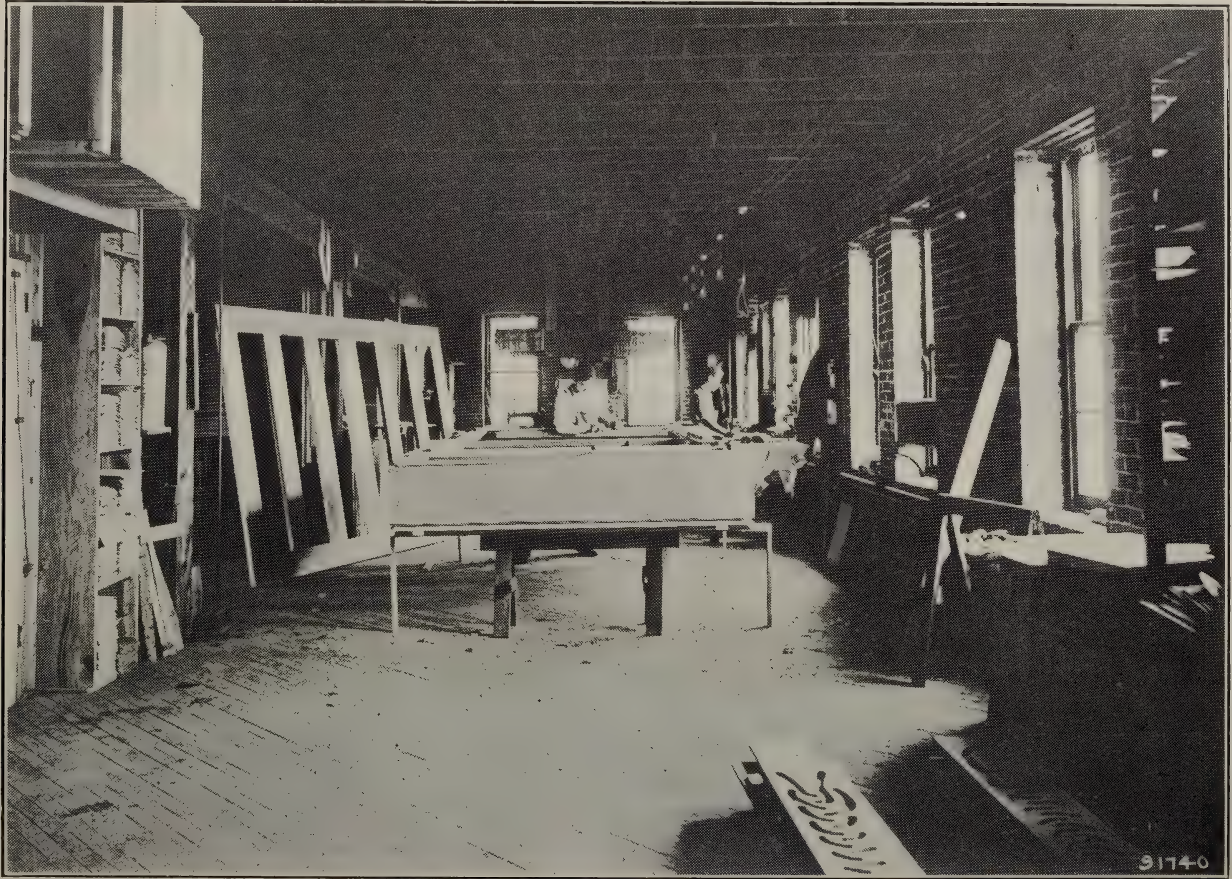

Fig. 27.—The manufacture of pipe organs.

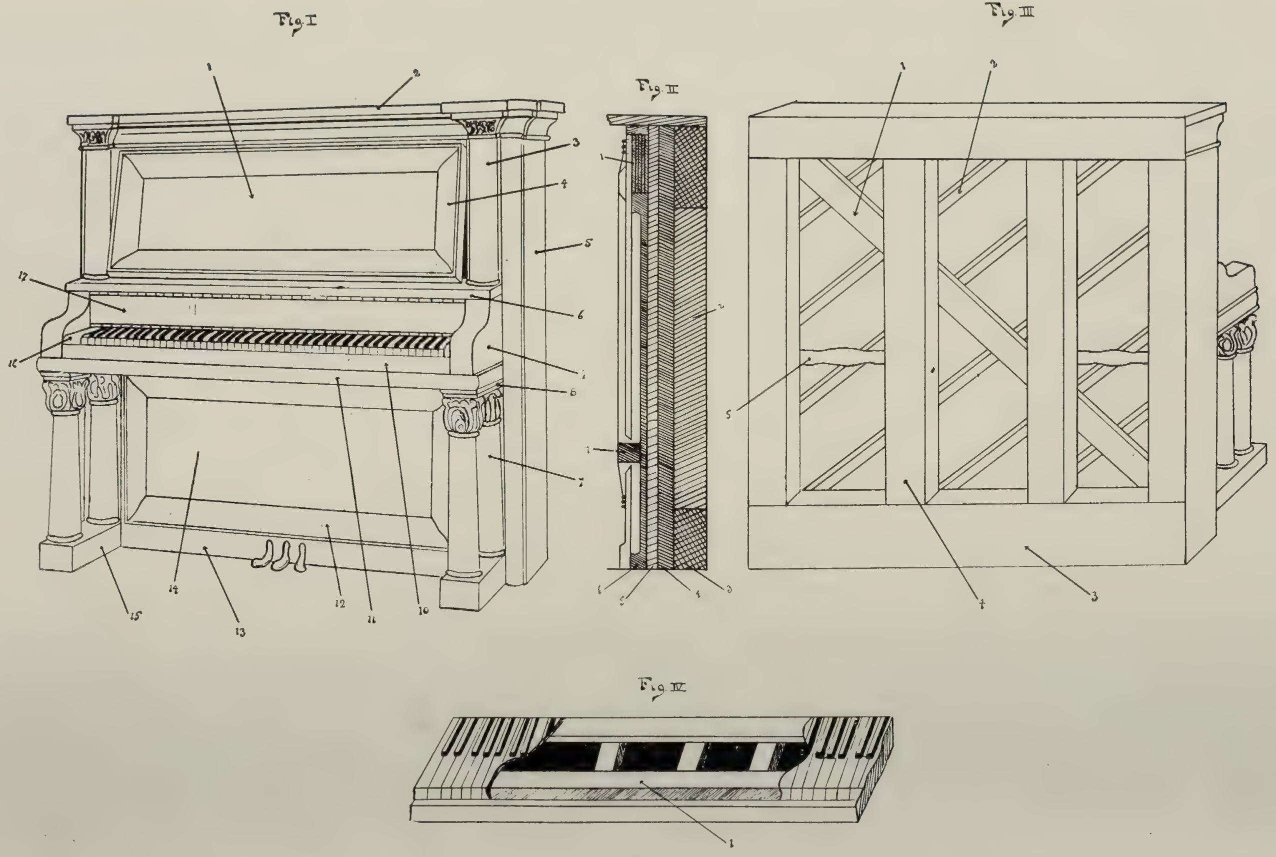

Fig. 28. Piano cases and kinds of wood used in their manufacture.

DESCRIPTION OF FIGURE 28.

UPRIGHT PIANO.

Figure I.

1. Top panel,
2. Top,
3. Pilaster,
4. Moulding,
5. Side,
6. Shelf,
7. Cheek,
8. Moulding,
9. Pilaster,
10. Key slip,
11. Key bottom,
12. Moulding,
13. Pedal board,
14. Bottom panel,
15. Feet,
16. Key block,
17. Fall board,

The cases of the cheaper pianos, as a rule, are made of solid wood, generally sweet birch, beech, or basswood, which is stained to imitate some higher priced wood. The cases of the more expensive instruments, with the exception of the smaller parts, as the moulding, fall boards, pilasters, and key blocks, are always veneered, the veneer being of a fine-finish wood such as mahogany, birds-eye maple, black and Circassian walnut, and rosewood, and from one to three-ply in thickness on a core of some good body wood such as sound wormy chestnut, red oak, yellow poplar, and white pine.

Figure II.

1. Pin blocks: Sugar Maple.
2. Posts: Sugar Maple, White Ash.
3. Back boards: White Ash, Sugar Maple.
4. Diagonal sweep: Spruce.
5. Sounding board ribs: Spruce.
6. Sounding board: Spruce.
7. Bridge: Spruce.

Figure III.

1. Diagonal sweep: Spruce.
2. Sounding board ribs: Spruce.
3. Back board: White Ash, Sugar Maple.
4. Posts: Sugar Maple, White Ash.
5. Handles: Sugar Maple, White Ash.

Figure IV.

1. Key bottom: White Ash, Sugar Maple, Yellow Poplar, White Pine, Mahogany.

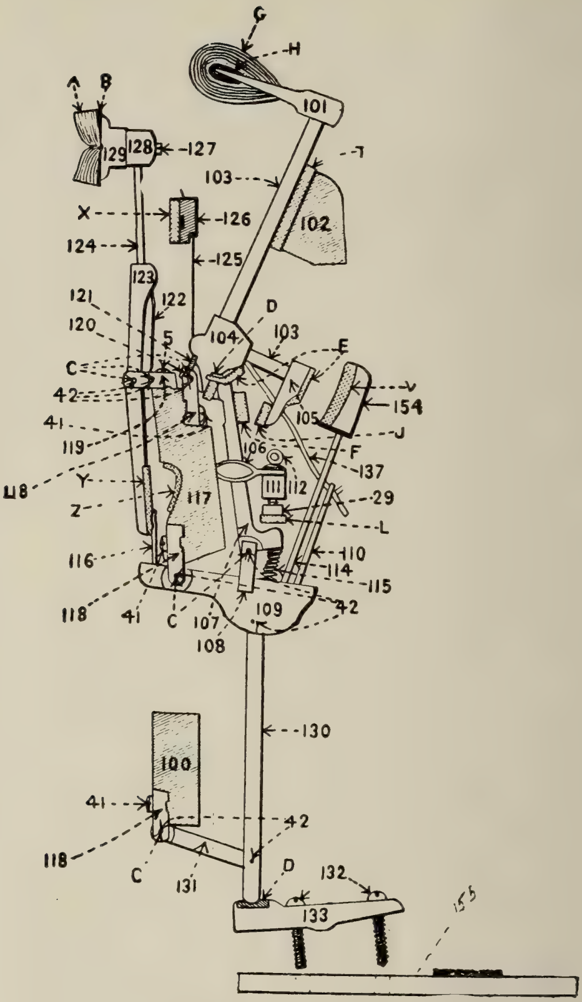

Fig. 29. Action parts of upright piano.

A—Damper felt.
B—Damper head lining felt.
C—Brushing cloth.
D—Action cloth.
E—Action leather.
F—Catcher felt.
G—Hammer top felt.
H—Hammer under felt.
J—Butt felt.
L—Regulating punchings.
T—Hammer rail cloth.
V—Back check felt.
X—Spring rail felt.
Y—Damper lever felt.
Z—Action cloth.

No.
5—Action screw.
29—Regulating button (Sugar Maple).
41—Action screw.
42—Center pins.
100—Lower flange rail (Sugar Maple).
101—Hammer moulding (Sugar Maple, Red Cedar, Mahogany).
102—Hammer rail (Sugar Maple, Mahogany, Birch).
103—Hammer shanks (Sugar Maple, Red Cedar).
104—Hammer butt (Sugar Maple).
105—Back stop (Sugar Maple).
106—Regulating rail bracket.

No.
107—Jack (Sugar Maple).
108—Fly flange (Sugar Maple).
109—Wippen (Sugar Maple).
110—Bridle wire.
111—Regulating rail (Sugar Maple, Birch).
112—Regulating rail screw.
114—Back check wire.
115—Jack Spring.
116—Damper spoon.
117—Center rail (Sugar Maple).
118—Flange (Sugar Maple).
119—Damper lever flange (Sugar Maple).
120—Action screw.
121—Butt plate.
122—Damper Spring.
123—Damper lever (Sugar Maple).
124—Damper wire.
125—Hammer butt spring.
126—Spring rail (Sugar Maple).
127—Action screw.
128—Damper block (Sugar Maple).
129—Damper head (Sugar Maple).
130—Abstract (Sugar Maple).
131—Tongue (Sugar Maple).
132—Jack screw, piano head.
133—Key rocker (Sugar Maple).
137—Bridle strap.
154—Back check (Sugar Maple).
155—Key (Sugar Maple).

Table 69—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Dogwood,	17,585	.52	69 60	1,224	......	17,585
Persimmon,	7,010	.21	60 06	421	......	7,010
Boxwood (West Indian),	1,350	.04	62 96	85	......	1,350
Sarbo,	30	*	200 00	6	......	30
Doncella,	10	*	100 00	1	......	10
Total,	3,347,985	100.00	$27 14	$90,888	1,970,000	1,377,985

*Less than 1-100 of 1 per cent.

DAIRYMEN'S AND POULTERERS' SUPPLIES.

The new methods in vogue for carrying on the dairy and creamery as well as the poultry business along scientific lines has brought about the use and manufacture of special equipment among which are included important articles made of wood. The factories manufacturing these articles are the ones that have supplied the data which has been compiled in the table following. They are in no way related and have been combined only for convenience in presenting the statistics since it is considered in this way the uses of the various woods may be more readily discussed. No one factory was found making the entire equipment for all of these above lines of business. They usually specialize either in one particular line or in the manufacture of a single commodity as incubators, butter tubs, egg crates, etc.

Under dairymen's supplies for Pennsylvania are grouped the making of churns, butter tubs, cheese boxes, churn vats, milk bottle washers, and curd grinders. Ash is the principal wood for churns, both for the staves and for the paddles because it retains its shape and is less liable than any other wood to impart taste. This wood is used for making all kinds from the small domestic churns propelled by hand to the large cylindrical churn used in creameries. For the same reason that ash is used for churns it is called for ahead of any other wood for making butter tubs and butter pails. Maple is used with it for bottoms and covers of butter tubs but the quantity is relatively small. In some states experiments have been made with cypress for butter tubs but it was not in use in Pennsylvania although it was reported with ash for churn vats. Over a million and a half feet of wood is required for making cheese boxes. Because white elm has the property of bending it is used for these commodities ahead of any other wood, not only in Pennsylvania, but elsewhere. Other woods are used in fairly large amounts probably more for the reason that they could be purchased cheaper than for any special adaptability. These woods include beech, yellow birch, oak, hemlock, and ash. Wooden parts of the curd grinding machines in cheese factories account for the appearance in the table of cottonwood, ironwood, and a large part of the sugar maple.

The manufacturers of poulterers' supplies required almost as much lumber as the factories making dairymen's equipment. Incubators and brooders were the commodities manufactured. Cypress in the largest amounts answered with yellow poplar and white pine for incubator cases and also for trays and other inside work. Its stability, affinity for paint and durability are the qualities desired for these uses. The bases and legs of incubators are of red oak and sugar maple, probably selected for strength. Brooder case woods are the same as for incubators except red oak instead of cypress went for frames.

Table 70.--Wood for Dairymen's, Poulterers', and Apiarists' Supplies, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White elm,	600,000	18.51	$25 00	$15,000	250,000	350,000
Cypress (bald),	545,000	16.82	37 02	20,175	......	545,000
Ash,	400,000	12.34	15 00	6,000	395,000	5,000
Basswood,	370,000	11.42	18 00	6,660	......	370,000
Yellow poplar,	220,000	6.79	29 82	6,560	......	220,000
Hemlock,	215,000	6.63	15 49	3,330	215,000	......
White oak,	205,000	6.33	18 90	3,875	200,000	5,000
Sugar maple,	152,950	4.72	27 96	4,276	23,500	129,450
Shortleaf pine,	145,000	4.48	15 69	2,275	......	145,000
Beech,	100,000	3.09	16 00	1,600	100,000	......
Birch,	100,000	3.08	18 00	1,800	100,000	......
White pine,	79,000	2.44	22 58	1,784	15,000	64,000
Red cedar,	45,000	1.39	55 00	2,475	......	45,000
Red oak,	36,000	1.11	28 00	1,008	......	36,000
Red and silver maple,	15,000	.46	10 00	150	15,000	......
Horbeam,	10,000	.31	12 00	120	10,000	......
Cottonwood,	2,500	.08	40 00	100	2,500	......
Total,	3,240,450	100.00	$23 82	$77,188	1,326,000	1,914,450

MUSICAL INSTRUMENTS.

A few manufacturers of this class specialize in building finished piano cases, and in the rough, which are called shells. Others make only the actions and keys. Others not included in this study buy their cases of one manufacturer, their actions of another, their sounding boards of a third, and their hardware from those specializing in that line, and operate merely in assembling the instrument and varnishing and finishing the exterior.

Chestnut which combines sufficient strength with light weight and has a special adaptability for holding glue is favored above all woods for backing veneered cases, and in the quantity consumed leads all other woods reported by the Pennsylvania piano makers and organ builders. It is entirely a case wood for piano cases. That so much of the chestnut reported should have been shiped from other states to the Pennsylvania piano makers is surprising because the chestnut tree is common throughout Pennsylvania, and in the production of chestnut lumber in 1912 Pennsylvania is among the three leading states. Other woods used for veneer backing were red oak, white pine, yellow poplar, and soft maple, because they possess qualities of sufficient strength, are stable in holding their shape, are easily worked, and have a special affinity for glue. The woods used for exterior finish include red oak, white oak, and red gum, Circassian walnut, sweet birch, mahogany, black walnut, and sugar maple. They are bought to a large extent as veneer because in that form the selection of the most attractive figures is possible. For the backs, posts, and diagonal sweeps, several species—sugar maple, beech, soft maple, yellow birch, and white ash contribute the material because hardness and strength are the properties demanded. The bridges are of spruce, maple, and white ash, because they hold their shape well and are strong. The bottom boards are made of maple, oak, and hemlock, and the pedal boards of sugar and soft maple.

Spruce is the most vibrant wood and therefore foremost for piano sounding boards and sounding board ribs. The red spruce native of the Appalachian and New England regions, and white spruce of the Lake states, have probably been preferred; but since sounding boards are made from wide stock of uniform structure, trees suitable for this purpose are sought over great distances. At present, therefore, sounding board material is shipped from the Northern Pacific Coast states and British Columbia, where Sitka spruce supplies the demand. Sounding board material which shows a number of small annual rings indicating a slow rate of growth is preferred and purchased for high priced pianos. It is usually cut from trees on high altitudes where the development is fairly restricted.

Sugar maple, because it is a hardwood and easy to shape, is most used for actions, although some manufacturers use mahogany and sweet birch for action rails and red cedar and mahogany for hammer moulding and hammer shanks. Sugar maple, owing mostly to its hardness, is used to the exclusion of other woods for pin blocks. Red gum comes in for action parts, and the fact that it has been reported for this use in several other states besides Pennsylvania shows that its qualities have proved it practical for this kind of work.

Piano and organ keys are usually from the upper grades of white pine and sugar maple, but in Pennsylvania basswood also served except for sharps or flats which, like the organ stops, are made of ebony. Ebony was not reported in Pennsylvania nor was any mention made of the manufacture of keys and stops indicating that these commodities are brought into the State ready manufactured. White ash, white pine, sugar maple, yellow poplar, and mahogany furnished the material for the key bottoms because they have little tendency to warp.

Black walnut which is used in larger quantities in this industry than in any other is demanded almost entirely for the outside finish or cases of both pipe and reed organs. White oak, red oak, red gum, cherry, cotton gum, and mahogany also served with it for this use and for consoles and pilasters added only ornamentation. The frames and sills of organ cases were of shortleaf pine, chestnut, hemlock, and red oak, the wind chests and bellows of yellow poplar, basswood, white pine, sugar pine from California, and redwood, while white pine, shortleaf pine and yellow poplar answered for swell boxes. White pine is the principal wood for organ pipes but cherry, sugar pine, and redwood were also reported. Action chests are of a strong wood and red oak supplied most of the material. It is interesting to note that redwood has begun to be used by the eastern manufacturers for interior organ parts. Being fairly strong compared to its light weight, easily worked, free from pitch, and possessing the property of holding its shape well are the reasons why it is held in high favor with the manufacturers and will probably be used more extensively in the future.

Table 71.—Wood for Musical Instruments, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Chestnut,	671,900	22.81	$24 81	$16,669	327,000	344,900
Sugar maple,	647,800	22.00	32 20	20,857	225,300	422,500
Spruce,	325,500	11.05	43 24	14,075	......	325,500
Basswood,	271,500	9.22	42 36	11,500	11,000	260,500
Mahogany,	201,100	6.83	83 11	16,713	......	201,100
Yellow poplar,	135,100	4.59	70 54	9,530	24,000	111,100
Black walnut,	131,200	4.46	44 05	5,779	67,700	63,500
Red oak,	102,000	3.46	32 25	3,290	......	102,000
Birch,	90,000	3.06	23 89	2,150	50,000	40,000
White oak,	88,000	2.99	53 90	4,743	33,000	55,000
White pine,	88,000	2.99	34 56	3,041	......	88,000
Red gum,	50,000	1.70	51 20	2,560	......	50,000
Red and silver maple,	44,000	1.49	26 82	1,180	......	44,000
Beech,	20,000	.68	22 00	440	......	20,000
Cotton gum,	20,000	.68	25 00	500	......	20,000
Shortleaf pine,	19,900	.67	34 52	687	......	19,900
Sugar pine,	11,200	.38	87 50	980	......	11,200
Redwood,	10,000	.34	40.00	400	......	10,000
Ash,	5,300	.18	44 34	235	5,000	300
Cherry (black),	4,400	.15	75 68	233	3,600	800
Loblolly pine,	3,000	.10	40 00	120	......	3,000
Hemlock,	2,600	.09	35 00	91	1,600	1,000
Cypress (bald),	2,500	.08	43 60	109	......	2,500
Total,	2,945,000	100.00	$39 38	$115,982	748,200	2,196,800

MACHINERY AND ELECTRICAL APPARATUS.

The wood used in Pennsylvania for making parts of electrical equipment is represented by Table 72. There are fourteen species required, their principal uses being:

Cable Reels.
- White pine.
- Shortleaf pine.
- Hemlock.
- Red oak.
- Spruce.

Wire Spools.
- Sugar maple.
- Yellow poplar.
- Basswood.
- Red oak.

Insulating Pieces.
- Sugar maple.

Relay Boxes.
- White pine.
- Red oak.

Switch Boards.
- Mahogany.

Wire Reels.
- Hemlock.
- White pine.
- Red oak.
- Yellow poplar.
- Spruce.

Electrical Cabinets and Cases.
- White ash.
- Walnut.
- Red oak.
- Sugar maple.
- Mahogany.
- Longleaf pine.

Trunking.
- Shortleaf pine.
- White pine.

Switch Signal Blades.
- White pine.
- White ash.
- Sugar maple.

The largest amount and greatest number of woods of this industry go into cable and wire reels and spools for small size insulated wire. It will be noted that the softwood or conifers not plentiful in Pennsylvania are preferred in their manufacture which probably accounts for so great a percentage of the material being shipped in from other states. Hemlock and black walnut were the only woods listed as wholly home-grown. Pennsylvania wire manufacturers use a much larger number of wood reels than is indicated in this table but because they are manufactured elsewhere and brought to the State ready for use after being assembled merely, information concerning this material was not asked for. It had previously been accredited to the state where the reels were actually manufactured.

Table 72.—Wood for Machinery and Electrical Apparatus, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Shortleaf pine,	968,200	35.66	$21 89	$21,191	......	968,200
White pine,	787,200	28.99	40 02	31,504	150,000	637,200
Sugar maple,	558,500	20.57	34 85	19,465	150,000	408,500
Hemlock,	143,600	5.29	26 85	3,856	143,600	....
Spruce,	87,700	3.23	26 00	2,280	......	87,700
White oak,	80,000	2.95	28 38	2,270	10,000	70,000
Red oak,	43,500	1.60	41 72	1,815	......	43,500
Ash,	25,000	.92	60 00	1,500	......	25,000
Yellow poplar,	10,000	.37	55 60	556	......	10,000
Mahogany,	6,000	.22	160 00	960	......	6,000
Black walnut,	2,500	.09	40 00	100	2,500	......
Basswood,	2,000	.07	55 60	111	......	2,000
Longleaf pine,	1,000	.04	25 00	25	......	1,000
Total,	2,775,200	100.00	$31 54	$85,633	456,100	2,259,100

WATER PIPES AND PUMPS.

Over two and one-half million feet of lumber is demanded annually in Pennsylvania for making wooden water pipes and wood linings for iron water pipes. In coal mining operations the chemical action of the water that collects there holds in solution various minerals, chiefly sulphur, that have a deleterious effect upon iron. Pipes employed for conducting this water away, when of iron, are usually lined with wood to prevent corrosion or, as in many cases, are made entirely of wood. White pine is demanded in the largest quantities for both of these purposes. The average price indicates that the lower grades were employed, as were the sugar maple, beech, and sweet birch and other species were used. Most of the white pine reported was State-grown, which is another instance of an industry at present depending on the forest resources of the State. Yellow poplar, the most expensive wood, came from a distance and went entirely into liquor logs, both for well and boat pumps, the latter used principally on boats for transporting ore coal and other heavy freight. In other states, according to quantity, cucumber is preferred for liquor logs, but unless it was mixed with yellow poplar, as is frequently done in marketing this wood, none was used in Pennsylvania.

Table 73.—Wood for Pumps, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White pine,	2,092,000	77.71	$24 59	$51,435	1,575,000	517,000
Sugar maple,	400,000	14.86	17 00	6,800	400,000	......
Yellow poplar,	100,000	3.71	45 00	4,500	......	100,000
Birch,	50,000	1.86	17 00	850	50,000	......
Beech,	50,000	1.86	15 00	750	50,000	......
Total,	2,692,000	100.00	$23 90	$64,335	2,075,000	617,000

BASKETS AND VENEER PACKAGES.

The products of this industry are made exclusively of veneer cut from close grained non-resinous woods with the tops and bottoms of thicker material—thin lumber,—which is often sawed from the cores (that part of the log after the veneer has been removed), or from low grades of lumber. Formerly splint baskets were the kinds used. There is a wide difference between split wood and woods suitable for veneers. The former require straight grained woods, easily rived. The sapwood of white oak, basket oak, cow oak, ash, and hickory were among those frequently used. After the introduction of rotary veneer machines they began to make them, as they are doing in Pennsylvania, from veneer cut into wide strips and woven; and cheaper woods, usually with close compact cross grain without much resin, have taken the place of the splint woods. For stave baskets a great deal of the veneer is cut into staves varying in length from 12 inches to 18 inches. The bottom is of solid edged lumber, to which the narrow ends of the staves are tacked. The staves are held in place at the top and added strength is given at the bottom by the use of thin cut rims of white elm, beech, and soft maple. These baskets are made in many sizes and have a bent handle which is often of beech, hard maple, and white elm. Various woods answer for the veneer part of the stave baskets; the principal ones reported by Pennsylvania manufacturers are beech, soft maple, elm, ash, birch, and black gum.

Other commodities made by this industry include packages used in marketing fruits and vegetables such as tills, hoppers, vendors' trays, and the like. This industry in Pennsylvania used a comparatively small amount of wood compared with the amounts used in Delaware, Maryland, Virginia, and North Carolina. The number of firms specializing in this line as well as in basket making justifies the grouping of the information concerning this line of manufacture into a separate industry instead of including it with the material going into boxes and crates, as has been the case in a number of other state reports where the veneer package industry is relatively unimportant.

Table 74.—Wood for Baskets and Veneer Packages, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Beech,	1,079,000	40.22	$18 62	$20,093	949,000	130,000
Sugar maple,	549,000	20.46	18 15	9,963	549,000	......
White pine,	230,000	8.57	21 00	4,830	230,000	......
Basswood,	220,000	8.20	20 18	4,440	220,000	......
Red and silver maple,	145,000	5.40	20 00	2,900	......	145,000
Red oak,	125,000	4.66	23 00	2,875	125,000	......
White elm,	115,000	4.29	21 87	2,515	115,000	......
Chestnut,	100,000	3.73	19 00	1,900	100,000	......
Birch,	70,000	2.61	22 43	1,570	70,000	......
Ash,	30,000	1.12	21 00	630	30,000	......
Black gum,	20,000	.74	22 00	440	20,000	......
Total,	2,683,000	100.00	$19 44	$52,156	2,408,000	275,000

FRAMES AND MOULDINGS.

Woods used in Pennsylvania for picture frame mouldings—plain, enameled, embossed, and carved,—electric wire moulding, and frames for school slates and blackboards, are listed in Table 75. This industry excludes all mouldings employed in the interior finish of houses except those which are put in place by the paper hangers for drop ceiling work and for picture hanging. Furniture, casket, and fixture moulding are grouped with the material respectively for the industries making these commodities.

Twenty-one woods are called on for the manufacture of the commodities mentioned above and scarcely one-fourth of the total quantity was cut from trees that grow within the State. Basswood is the principal material used, exceeding three times the total of all others. It went principally for fancy finish such as gilt, enamel, and embossed mouldings. Basswood not only holds paint well but keeps its shape and is easy to work and to cut, nail, and fit to place. Yellow poplar met part of the demand but was consumed in relatively small quantities. Frames displaying the figure of the wood are usually the highest priced moulding. Mahogany, white oak, black walnut, ash, and chestnut are called on by the Pennsylvania manufacturers for these lines of work if they are finished in oil or wax to bring out the natural beauty of the wood or else are darkened by stains or ammonia fumes for mission effects. Red gum is an important wood in this industry. It stood third in a similar table in Illinois, second in Michigan, and fourth in New York. It answers with sweet birch for the imitation of expensive woods.

Considerably over half a million feet of lumber each year is demanded in Pennsylvania for mouldings to conceal and protect electric wiring on walls and ceilings. Shortleaf pine and red oak were used in small quantities, but basswood met practically all the demand. Slate frames, except those covered with cloth, were entirely of beech. Basswood answered for the felt-bound ones and together with spruce supplied the material for blackboard frames.

Table 75.—Wood for Frames and Mouldings, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Beech,	1,200,000	45.82	$20 08	$24,100	600,000	600,000
Basswood,	902,000	34.44	23 09	20,825	352,000	550,000
White oak,	107,000	4.09	55 46	5,934	27,000	80,000
Spruce,	100,000	3.82	30 00	3,000	......	100,000
Chestnut,	93,000	3.55	22 41	2,084	25,000	68,000
Yellow poplar,	87,000	3.32	38 51	3,350	......	87,000
Red gum,	50,000	1.91	30 00	1,500	......	50,000
Sugar maple,	20,000	.76	22 50	450	20,000	......
Mahogany,	15,000	.57	120 00	1,800	......	15,000
Red oak,	12,000	.46	44 00	528	2,000	10,000
Black walnut,	10,500	.40	80 67	847	4,500	6,000
Ash,	10,000	.38	35 00	350	10,000	......
Birch,	7,500	.29	75 00	562	......	7,500
Shortleaf pine,	5,000	.19	30 00	150	......	5,000
Total,	2,619,000	100.00	$25 00	$65,480	1,040,500	1,578,500

REFRIGERATORS AND KITCHEN CABINETS.

Table 76 lists the woods used in Pennsylvania in the manufacture of refrigerators, kitchen cabinets, and cupboards. The combination cabinets and cupboards have become almost indispensable to housekeepers in that they provide a convenient place for all the accessories to cooking that are necessary to be kept at hand. In late years they have become popular and factories making them specialize in this line. Because they are sold at low prices they are not usually made of the upper grades of lumber that are employed in the manufacture of furniture. Yellow poplar and oak, both red and white, and to a limited extent birch, are the woods mainly used in Pennsylvania for the case or outside work. The interior parts, such as shelving, compartment partitions, drawer sides and bottoms, etc., are made of yellow poplar, spruce, cottonwood, maple and beech. The backs of these cases are also made of low grade material and none of special quality or kind was demanded. Almost any cheap species, easily worked, will answer. In consequence, a proportion of nearly all listed in the table served for this use. Shortleaf pine, spruce, and white oak were reported for framing.

Refrigerators run from what are practically small ice boxes to large sectional cases the size of a room used by butchers and others doing business requiring cold storage equipment. Refrigerators and chests for domestic purposes call for soft woods of conifers for linings. The reason for this is that many hardwoods have an odor and therefore are unfit for a storage compartment of perishable foodstuffs. Spruce is the principal lining material in Pennsylvania, and was also employed for ice pan supports. Cypress in some states is used for this purpose and in others white and yellow pine is used. The siding or outer case is usually hardwood,—white oak, white ash, red oak, birch, cherry, and red gum. They are selected as being not only best for the work intended, but the exterior properly finished gives the chest the appearance of an article of furniture. The case is not attached to the lining, since between the lining and the case there is provided an insulation space, which in some refrigerators is filled with materials like sawdust, cork, and charcoal, and in other refrigerators the space is left unfilled, the dead air being regarded the most effective insulation. Lumber for refrigerators must be well dried as otherwise the extreme variations of temperature are apt to cause it to buckle and check. The large refrigerators or cooling rooms are built to order in the place in which they are used. Though hardwoods are called on for the exterior or case work of the higher priced work, softwoods answer to a considerable extent both for the linings and cases. The materials for both of these parts are usually rather thick and are preferred to guard more effectively against the penetration of heat. It is possible, so the Pennsylvania manufacturers claim, to secure a temperature of 38 degrees from ice alone in these large refrigerators.

Table 76.—Wood for Refrigerators and Kitchen Cabinets, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Yellow poplar,	566,200	22.98	$28 27	$16,009	363,000	203,200
Shortleaf pine,	453,750	18.42	27 07	12,284	......	453,750
White oak,	448,450	18.20	30 44	13,649	250,000	198,450
Spruce,	413,800	16.79	37 39	15,474	190,000	223,800
Cottonwood,	150,000	6.09	32 00	4,800	......	150,000
Red oak,	117,450	4.77	41 91	4,922	......	117,450
Sugar maple,	80,750	3.28	28 71	2,318	80,750	......
Birch,	65,000	2.64	25 15	1,635	30,000	35,000
Beech,	55,000	2.23	17 36	955	30,000	25,000
Hemlock,	37,100	1.50	22 13	821	33,100	4,000
Ash,	32,000	1.30	38 19	1,222	4,000	28,000
Basswood,	21,600	.88	31 11	672	1,600	20,000
Chestnut,	11,800	.48	28 05	331	11,800	......
Cherry (black),	7,500	.30	62 50	469	7,500	......
Red gum,	2,900	.12	50 00	145	......	2,900
White pine,	500	.02	28 00	14	500	......
Total,	2,463,800	100.00	$30 73	$75,720	1,002,250	1,461,550

EXCELSIOR.

Formerly excelsior was called wood fiber but later it received its present name given it by an upholstery firm in its advertisement. In 1860 this commodity was first placed on the market by a Maine manufacturer, but it was not called on to meet much of a demand for a decade; then with the improved machinery invented by Europeans the manufacture of excelsior was greatly facilitated. Since that time it has become a staple product. According to a recent report by the Forest Service and the Bureau of the Census, it was ascertained that 85,000,000 feet of forest material is yearly demanded for its manufacture. Pennsylvania is not so important an excelsior state as either Virginia or New York, the former being second and the latter third. Pennsylvania is the tenth, consuming each year over one and a half million feet of wood all cut within the State. In the New England

and Lake states, aspen or popple, basswood and willow are used; in Virginia and North Carolina, scrub and loblolly pine, yellow poplar, and white pine meet the demand. In the Mississippi Valley states excelsior makers report the use of cottonwood, yellow poplar and yellow pine, and in the Pacific coast states black cottonwood alone furnishes all of the demand. For the United States, in quantity, aspen is the favorite excelsior wood, yellow pine next. Pennsylvania manufacturers prefer basswood and yellow poplar next. These woods with aspen make the best grades of excelsior. The consumption of yellow poplar in this line of manufacture is greater in Pennsylvania than in any other state, though it is used in eight others. Butternut appears in only one other state, New Jersey, and, next to Michigan, beech finds its greatest demand in Pennsylvania for excelsior. Chestnut excelsior is solely a product of Pennsylvania and until this investigation, the Forest Service had received no record of the use of this wood for this purpose. Excelsior wood should be straight grained, soft, dense, light in weight and color, moderately non-brittle, stiff when dry, and odorless.

The raw material used for making excelsior comes in the form of bolts and split billets, usually in lengths the multiples of 18 inches. The wood is thoroughly seasoned before manufacturing but if seasoned too long it becomes brittle and often is injured by certain forms of incipient decay. The billets are set in the excelsior machines and without further handling are shaved into the finished product. The output of an eight block machine varies from 6,000 to 10,000 pounds per day according to the fineness of the product. From the cutting machines the excelsior is taken to the baling room where presses, similar in operation to hay balers, put it into marketable form.

The first use of excelsior was for packing wares liable to injury in transportation, but later it proved valuable for filling cheap mattresses and upholstered furniture. In France not only does excelsior answer for this purpose, but highly improved machinery has made it possible to manufacture a product of such fine grade as to be a fit substitute for the absorbent lint used in hospital, or filtration purposes, and for weaving into floor coverings. Various grades of excelsior are frequently dyed without losing their elasticity. They serve as an ornamental packing material, and for color schemes in displaying goods in show cases, but none was reported in Pennsylvania. Table 77 gives the available statistics.

Table 77.—Wood for Excelsior, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Basswood,	749,000	44.53	$13 77	$10,315	749,000	......
Yellow poplar,	688,000	40.90	15 00	10,030	688,000	......
Beech,	116,500	6.93	15 00	1,748	116,500	......
White pine,	63,500	3.78	15 00	953	63,500	......
Butternut,	30,000	1.78	15 00	450	30,000	......
Aspen (popple),	30,000	1.78	15 00	450	30,000	......
Chestnut,	5,000	.30	14 00	70	5,000	......
Total,	1,682,000	100.00	$14 28	$24,016	1,682,000	......

PLAYGROUND EQUIPMENT.

Under this industry are listed the woods used for making apparatus or wooden parts thereof that contribute equipment for public parks and playgrounds. Swings, merry-go-rounds, coasting boards, ferris wheels, croquet sets, see-saws, shoot-the-chutes, etc., are examples of the principal ones. Swings, however, were the only commodities manufactured in Pennsylvania. The total of the following table, 1,507,300 feet, represents the amount of material that is required each year for their manufacture. Not all of this material went into playground swings since swings of every description are included and some required more lumber for making than others. According to quantity consumed, lawn and porch swings are the most important. The latter answer not only for amusement but are also useful as furniture,—a suspended settee for porch appointments. Of late this commodity has grown rapidly in favor.

Nine woods are listed in Table 78, and those species best suited for swing material, i. e., those possessing the necessary inherent qualities of strength, hardness, and durability when exposed are the ones included. The oaks, beech, and ashes in the order named, were the most prominent hardwoods. The chief conifers used were longleaf, shortleaf, and loblolly pine, the last named being used in the largest quantities. The pines answered mostly for lawn swings and principally for the staffs and the frame work or superstructure.

Table 78.—Wood for Playground Equipment, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Red oak,	456,300	30.27	$32 23	$14,707	216,300	240,000
Loblolly pine,	400,000	26.54	20 00	8,000	......	400,000
Shortleaf pine,	240,000	15.92	27 00	6,480	......	240,000
White oak,	151,000	10.02	37 95	5,730	98,500	52,500
Beech,	130,000	8.62	29 46	3,830	130,000	......
Ash,	75,000	4.98	33 00	2,475	37,500	37,500
Yellow poplar,	25,000	1.66	36 00	900	12,500	12,500
Sugar maple,	23,000	1.53	26 96	620	3,000	20,000
Longleaf pine,	7,000	.46	52 00	364	......	7,000
Total,	1,507,300	100.00	$28 60	$43,106	497,800	1,009,500

PRINTING MATERIAL.

Electrotype backing, woodcut engravings, and wood type are the only products listed under this head. Four woods were demanded for their making. Cherry heads the list as to quantity and went entirely into electrotype mountings, which is probably the most exacting use it has. Because it is less liable to warp than any other American woods that possess the other requisite qualities for this use is the reason the electrotypers demand cherry exclusively. Its strength and density, its resistence to splitting, and its property to work smoothly are other important qualities which commend it. Electrotype backing is not made, as formerly, entirely from solid lumber. Glue is to a large extent called on to put together narrow strips or thin layers for built-up mountings that are beginning to be used extensively. The growing scarcity of cherry, together with the rapidly increasing demand for this line of work requires the electrotypers to pay a price over twice as great as that asked five years ago.

For wood engravings, boxwood from Turkey and Russia was the only wood reported and in other states as well it met most of the demand, especially for high grade work. It is the most expensive wood that is listed in any industry. The price, $1,300 per thousand feet, is little, if any, above the usual cost of this wood for engravings and it is usually sold in terms of cubic inches, four cents being the average reported in Philadelphia. Owing to the high cost of this wood, engravers employ domestic substitutes to a large extent, but they are for the cheaper grades of work. Sugar maple, apple, and pearwood are the kinds most used.

Metal has almost entirely replaced wood for printer's type. Wood is still called for to a limited extent, chiefly for manufacturing large size type such as is used for printing billboard advertisements. Formerly boxwood furnished the material, but its high cost now stands in the way and sugar maple, which was the only wood reported in Pennsylvania, now furnishes most of the supply.

Table 79.—Wood for Printing Material, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Cherry (black),	1,166,800	91.56	$29 14	$34,003	634,000	532,800
Birch,	30,000	2.36	50 00	1,500	10,000	20,000
Red and silver maple,	25,000	1.96	31 60	790	20,000	5,000
Mahogany,	23,500	1.84	85 96	2,020	......	23,500
Redwood,	20,000	1.57	63 00	1,260	......	20,000
Yellow poplar,	5,000	.39	18 00	90	......	5,000
Beech,	2,000	.16	30 00	60	2,000	......
Applewood,	1,000	.08	50 00	50	1,000	......
Sugar maple,	500	.04	80 00	40	500	......
Hickory,	500	.04	50 00	25	500	......
Boxwood (Turkish),	26	*	576 92	15	......	26
Total,	1,274,326	100.00	$31 27	$39,853	668,000	606,326

*Less than 1-100 of 1 per cent.

LADDERS.

Nine manufacturers reported the making of ladders, including step ladders, travelling store ladders, firemen's ladders, and extension ladders used by painters and other mechanics. In other state reports ladders have been classified under woodenware but owing to the number of concerns in Pennsylvania specializing in making them and because of the large quantity of wood which they annually consume, their presentation under a separate heading is justified.

Loblolly pine and basswood supplied the largest part of the demand and were called on mostly for step ladders because being strong and at the same time light in weight they are well adapted for this line of use. Beech was used extensively for steps because of its strength, and in order not to make the ladders too heavy, it was used with a lighter wood for styles. Other step ladder woods were cypress, longleaf pine, and spruce. The staffs, which are the hinged supports, are made of various woods and usually of the same kind as the styles except those of considerable length where extra strength is desired. In order not to add too much weight staffs are made of strips of small dimension and to meet the stress imposed are well braced and made from material free from imperfections. For extension and firemen's ladders high grades are used. Spruce is most in demand for the styles or uprights while for the ladder rungs, hickory, ash, beech, and maple were employed in the order mentioned.

Travelling ladders are so named because they are readily moved by the occupant without descending. They are used in stores. Pulleys, movable on a track, are attached at the top, and in some designs the bottoms rest on castors. Lightness of weight is not a consideration in these as in step ladders and thicker materials and heavier woods are therefore used. Longleaf pine was used mostly but sugar maple, loblolly, and shortleaf pine also met a part of the demand.

Sixty-five per cent. of the ladder woods were kinds that do not grow plentifully and some not at all in Pennsylvania. This accounts for only 20 per cent. of the requirements of this industry being met by the forests of the State. Of the kinds reported common to Pennsylvania, the entire amounts consumed were home-grown except basswood, nearly one-half of which was brought in from forests of other states.

Table 80.—Wood for Ladders, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Loblolly pine,	400,000	36.08	$20 00	$8,000	....	400,000
Basswood,	275,000	24.81	29 18	8,025	150,000	125,000
Spruce,	191,000	17.23	43 40	8,290	......	191,000
Cypress (bald),	62,500	5.64	54 64	3,415	......	62,500
Longleaf pine,	50,000	4.51	28 00	1,400	......	50,000
Sugar maple,	50,000	4.51	27 00	1,350	50,000	......
Hickory,	25,000	2.26	18 00	450	25,000	......
Shortleaf pine,	25,000	2.26	25 00	625	......	25,000
Beech,	22,000	1.98	18 27	402	22,000	......
Ash,	4,000	.36	70 00	280	4,000	......
Yellow poplar,	4,000	.36	21 00	84	......	4,000
Total,	1,108,500	100.00	$29 16	$32,321	251,000	857,500

ELEVATORS.

Fifteen manufacturers reported using wood for the manufacture and repair of freight and passenger elevators, both hand power and traction, lifts, dumb waiters, etc., and many of them are important industries maintaining formidable establishments. In the production of the finished commodity they give Pennsylvania a high standing among the states but in consumption of lumber they report the use of only a little over a million feet, annually, making this industry 35th in the list or 17th from the last. Not many years ago lumber was the most essential material the elevator manufacturers used but generally steel construction began to take the place of wood and proved to be such a practical and desirable substitute that now for power elevators, especially passenger, wood is employed only incidentally for a few minor parts. The sight of the old time wooden passenger elevator car today is an exception, but on the other hand many small freight elevators and dumb waiters are made entirely of wood, the initial cost being much lower than steel. Some are made that are part steel and part wood. The rough lumber demanded for elevator construction is shown in Table 81. Eleven kinds were reported and their principal uses are as follows:

PASSENGER ELEVATORS.

Car Platforms.
Sugar maple.

Overhead Machine Platform.
Sugar maple.

FREIGHT ELEVATORS.

Guide Posts.
White pine.
Longleaf pine.
Norway pine.

Guide Strips.
Sugar maple.
White ash.

Upper Frames.
Sugar maple.
Longleaf pine.
White ash.

Enclosures.
Longleaf pine.
White pine.
Loblolly pine.

Gates.
White oak.
Loblolly pine.

Car Platforms.
Sugar maple.
Cypress.
Longleaf pine.

Panel Sides.
Longleaf pine.
Loblolly pine.
White oak.
Sugar maple.

Overhead Beams.
Sugar maple.
Longleaf pine.
Loblolly pine.
White ash.

Car Beams.
Sugar maple.
White elm.
White oak.
Norway pine.

Weight jams.
Longleaf pine.
Sugar maple.
White elm.

Footing Pieces.
Longleaf pine.
Norway pine.
Sugar maple.
Cork elm.

DUMB WAITERS.

Car Frames.
Spruce.
Cork elm.
Longleaf pine.
Sugar maple.

Shaft Lining.
White oak.
Hemlock.
Chestnut.
Loblolly pine.

Car Finish.
Yellow poplar.
Loblolly pine.
White pine.

Guide Posts.
Yellow poplar.
White pine.

Guide Strips.
White ash.
Sugar maple.

Weight Jams.
Yellow poplar.
White pine.
Cork elm.

Weight Boxing.
Loblolly pine.
Yellow poplar.
White pine.

This industry does not depend on the forests of the State to any great extent as a source of raw material. Less than one-quarter of the total was grown in Pennsylvania because the lumber chiefly used in elevator construction is of kinds that are rarely, if at all, cut in Pennsylvania. Longleaf, Norway or red, loblolly, and shortleaf pine, and cypress together constitute over 52 per cent. of the total. Sugar maple and ash were the principal home-grown woods demanded and from the average prices recorded the upper grades were principally purchased. The available statistics are:

Table 81.—Wood for Elevators, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Longleaf pine,	269,900	26.75	$36 73	$9,913	....	269,900
Sugar maple,	141,200	14.00	49 74	7,023	81,200	60,000
Norway pine,	100,000	9.91	28 00	2,800	....	100,000
Loblolly pine,	96,500	9.56	32 31	3,118	....	96,500
Ash,	93,000	9.22	71 17	6,619	43,600	49,400
Yellow poplar,	82,600	8.19	41 88	3,459	30,600	52,000
White pine,	62,200	6.16	40 45	2,516	32,200	30,000
White oak,	53,200	5.27	48 03	2,555	23,200	30,000
Shortleaf pine,	50,000	4.96	22 00	1,100	....	50,000
Cork elm,	20,500	2.03	65 00	1,332	20,500	....
White elm,	12,000	1.19	65 00	780	....	12,000
Cypress (bald),	10,000	.99	55 00	550	....	10,000
Spruce,	10,000	.99	30 00	300	10,000	....
Chestnut,	4,000	.40	70 00	280	....	4,000
Hemlock,	3,800	.38	30 00	114	3,800	....
Total,	1,008,900	100.00	$42 08	$42,459	245,100	763,800

CANES AND WHIPS.

The variety of woods used for canes, umbrella and parasol handles exceeds that reported by any other industry in Pennsylvania. Table 82 includes 72 species of wood. Because the raw material for these commodities is most usually purchased in billet, pole or twig form, and very frequently by the piece, it was impractical to reduce the amount of the material reported to board feet except in a few cases when certain woods were used in comparatively large quantities. The total of Table 82 does not, therefore, represent the entire amount of wood that is used for manufacturing these products in Pennsylvania, but in order that the remarkable number of different kinds of wood,—many of which have not been reported in any other state report,—may be presented, they have been listed in the table without accompanying statistics. Most of them are high priced and a majority are foreign woods. As many as were readily available will be found included in the preceding illustration. A large per cent. of all the sugar maple and soft maple shown in the table went for dowels or shanks of umbrellas and parasols, while the entire amount of beech answered for whip stocks and handles. Reed cut in large quantities from rattan shipped from the Orient was also used for whips but it was reported in pounds and could not be reduced to feet to be included in the table.

Table 82.—Wood for Whips, Canes, and Umbrella Sticks, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Beech,	266,500	30.18	$21 91	$5,838	252,000	14,500
Sugar maple,	241,100	27.31	17 57	4,237	241,100	....
Ebony,	124,150	14.06	187 94	23,333	....	124,150
Red and silver maple,	107,000	12.12	26 45	2,830	2,000	105,000
Congo,	60,000	6.80	133 00	8,000	....	60,000
Hickory,	26,000	2.94	55 85	1,452	....	26,000
Boxwood,	25,600	2.90	363 28	9,300	....	25,600
Red gum,	20,000	2.27	50 00	1,000	....	20,000
Basswood,	12,500	1.42	32 48	406	5,000	7,500
Weichsal roots,	30	*	540 00	16	....	30
Total,	882,880	100.00	$63 90	$56,412	500,100	382,780

*Less than 1-100 of 1 per cent.

Woods for canes and parasol and umbrella handles purchased by the piece:

Apple.
Apricot.
Arbor vitae.
Bamboo.
Birch.
Black ash.
Black gum.
Black walnut.
Butternut.
Cherry.
Chestnut.
Chestnut oak.
Circassian walnut.
Corra.
Crab apple.
Cucumber.
Dogwood.
Elm.
English oak.
French oak.
Furze.
Hazelnut.
Haw (black thorn).
Holly.
Hop tree (hopwood).
Hornbeam (ironwood).
Huckleberry tree.
Lancewood.
Laurel.
Lilac.
Madagascar.
Mahogany.
Malacca (rattan).
Morello cherry (sweet cherry).
Orange wood.
Osage orange.
Paper birch (gray birch).
Partridge.
Peach tree.
Pear tree.
Persimmon.
Plum.
Poison Sumach.
Quince.

Red cedar (juniper).
Red oak (jersey oak).
Rice root.
Sassafras.
Savin (red cedar).
Scotch thistle.
Siberian crab.
Slippery elm.
Striped maple (swamp dogwood).
Sweet (cherry) birch.
Sycamore.
Whangee.
White ash.
White oak.
White thorn.
Willow.
Yellow birch.
Yellow poplar (hickory poplar).

PLUMBERS' WOODWORK.

In connection with bathroom and toilet furnishings and other forms of plumbing installation there are certain useful commodities made of wood which have been grouped under this heading and the materials used for making them presented in Table 83. Drainboards, which serve as dish washing tables, connected with the sink, call for a large quantity of wood which, on account of holding its shape, ash alone supplied. Usually these boards are grooved to facilitate drainage. Sweet birch, finished with a high polish, was mainly used for bath stools, some in imitation of mahogany but most of them painted or enameled white, the birch being specially adaptable to both kinds of finish. Water closet seats, lids, and tanks, are the other commodities of this industry in Pennsylvania and like the wood for fixtures and furniture, high grade material with considerable figure and susceptible of taking a polish is largely demanded. Yellow poplar is an exception as it answers in large amounts only for white enameled finish and is desired because it holds its shape, takes paint readily, and is moderately strong. Birch is probably equally suitable except that it is more liable to warp, but this is overcome in the superior advantages it offers in being stronger and affording a higher polish. White and red oak, including considerable quartered stock, cherry, mahogany, ash, and sweet birch used for exterior work are the woods selected for figure and are finished natural with wax or varnish. Chestnut in some states was reported among these woods but in Pennsylvania where it is extensively cut, the manufacturers of plumbing woodwork made no mention of it. This industry does not depend largely upon the forests of the State as the manufacturers report only 15 per cent. of all the wood they used as State-grown.

Table 83.—Wood for Plumbers' Woodwork, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
[illegible]	[illegible]	[illegible]	[illegible]	$8,297	[illegible]	119,500
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 83—Concluded.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Shortleaf pine,	12,250	2.10	28 00	343	....	12,250
Mahogany,	6,000	1.03	155 00	930	....	6,000
Cherry (black),	4,400	.75	94 55	416	400	4,000
White pine,	2,500	.43	36 00	90	....	2,500
Sugar maple,	300	.05	30 00	9	....	300
Black walnut,	300	.05	35 00	10	300	....
Total,	584,250	100.00	$39,43	$23,035	145,700	438,550

INSULATOR PINS AND BRACKETS.

Durability and strength are the requisite qualities of insulator pin material, and locust is the wood principally used in their manufacture. In the country at large, its use for this purpose exceeds seven times the amount of all other woods combined and in Pennsylvania over 425,000 feet are used each year. White oak, red oak, elm, and osage orange are other woods used for pins in various states, but, unlike locust, where these are employed they are ordinarily dipped in paint or some antiseptic solution, such as creosote, in order to increase their durability. In Pennsylvania locust was the only wood reported for insulator pins and the other woods appearing in the table were used for pole brackets.

Table 84.—Wood for Insulator Pins and Brackets, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Locust (black),	463,500	80.12	$23 90	$11,076	463,500	....
White oak,	60,000	10.37	13 33	800	60,000	....
Red oak,	55,000	9.51	11 82	650	55,000	....
Total,	578,500	100.00	$21 65	$12,526	578,500	....

BUTCHERS' BLOCKS AND SKEWERS.

The two important woods for butchers blocks are sycamore and sugar maple. On account of their desired qualities, hardness and uncleavability, together with their strength and tastelessness, they are first among the domestic woods for this use. Formerly butchers' blocks were round, usually a cross section of a large tree barked and trimmed symmetrically, varying in thickness from 18 to 30 inches. It is exceedingly difficult to season pieces of this size thoroughly and trouble results by blocks checking, rendering it difficult to keep them clean and sanitary. Lately considerable improvement in seasoning processes has partly overcome the only objection to sycamore blocks. The advancement made in the art of gluing woods, which has brought into prominence built-up lumber, has entirely overcome all checking difficulties and enabled the making of blocks lighter in weight but with requisite strength, equally as serviceable and with a more attractive appearance.

The built-up block is the only kind of block being made in Pennsylvania, and sugar maple is the wood used. The size of the pieces that are glued differ slightly according to the dimensions of the finished block but most commonly they are 3 inches thick, 4 inches wide, and 16 to 18 inches long. It is very important that the lumber for the blocks be thoroughly seasoned and to bring it to the desired condition both air and kiln-drying methods are used. Before gluing the pieces together, they are jointed by machinery in order that they fit perfectly, leaving no apertures along edges for glue to collect and thus taint the meat. That they may more readily adhere to the glue the smooth flat surfaces are roughened. This process is important since the rough usage given the meat block brings great strain on the glued joints which must be as strong as it is possible for the best glue to make them. The flat glue joint is used and to weld the pieces together after being heated and covered with glue, they are subjected for 12 or 14 hours to the pressure of a hydraulic machine. They are then bored for several iron rods that are added as a reinforcement for the glued joints. The legs are made usually of the same kind of wood as the meat blocks, namely, maple, but sometimes red oak is used.

Hickory and white pine are the principal woods used for skewers. Those made from the latter wood are employed in kitchens for holding in shape croquettes and other dainties and by confectioners for taffy sticks. Hickory skewers were made to meet the demand of the butchers. Beech and maple are prominent for meat skewers but none were reported by the manufacturers in Pennsylvania where these woods are common lumber trees.

Table 85.—Wood for Butchers' Blocks and Skewers, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Sugar maple,	270,000	51.92	$20 37	$5,500	270,000	....
White pine,	200,000	38.46	22 00	4,400	200,000	....
Hickory,	50,000	9.62	18 00	900	50,000	....
Total,	520,000	100.00	$20 77	$10,800	520,000	....

WEIGHING APPARATUS.

This industry as measured by the consumption of wood is one of the small ones of this report. It includes material for scale manufacture such as is used by railroads, called track scales and hay wagon scales, often used in coal yards, besides platform and counter scales for stores, warehouses, and cabinet scales such as are used for compounding medicines, weighing gold, silver, and precious stones.

Longleaf pine is the most common wood for large scales on account of its durability, strength, and elasticity. It goes principally into the framework of track and wagon scales and was shipped to Pennsylvania from the Gulf states. Sugar maple is next in quantity answering more for the counter and platform scales than any other use because, being hard, tough, strong, and close grained with a tendency to wear smooth, it is specially adapted for this purpose. The handsome finish of mahogany and cherry, together with their compact structure, and the property of holding their shape, commend them for use as material for making the basal parts of cabinet scales and for the frame of the glass cases usually enclosing these scales.

Table 86.—Wood for Weighing Apparatus, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Longleaf pine,	200,000	50.84	$30 00	$6,000	....	200,000
Sugar maple,	171,000	43.47	33 13	5,665	21,000	150,000
Yellow poplar,	10,000	2.54	25 00	250	10,000	....
Cherry (black),	7,500	1.90	27 00	202	7,500	....
Mahogany,	4,000	1.02	90 00	360	....	4,000
Ash,	900	.23	93 06	84	900	....
Total,	393,400	100.00	$31 93	$12,561	39,400	354,000

PROFESSIONAL AND SCIENTIFIC INSTRUMENTS.

The amount of lumber used by this industry is relatively very small, but the products grouped under it are numerous and vary according to the uses they serve in the several trades or professions included. In the quantity of wood used the pencil makers are the most important class. Similar to the pencil manufacturers in New Jersey, New York, and other states, they report using only one wood, red cedar, which is brought to Pennsylvania from the southern states. Tennessee and Florida are at present the centers of production of this wood. Other kinds, both domestic and foreign, have been considered as possible substitutes because of the growing scarcity of red cedar, but the experiments indicate that only a few species have been found fairly successful and these answer mostly for a cheap pencil. This brings out how difficult it is to find a wood combining all the qualities requisite for pencil material and how essential it is that pencil woods possess qualities almost identical to red cedar. Pencil makers procure their raw material in the form of slats that are usually 2½ inches wide and 7 inches long, and ¼ inch thick. Not frequently the pencil makers manufacture their own slats, but there are concerns specializing in cedar products who convert their best material into pencil slats and the remainder into lumber for utility boxes, furniture squares, and closet linings. Formerly when cedar was abundant pencil slats were manufactured entirely from logs, but rapidly decreasing supply of cedar timber has brought into the market old stumps, fence rails, gate posts, barn and cabin logs, and material in various shapes and condition, even partly decayed and weather checked. As can be expected, therefore, waste incident to the sawing of pencil slats is large and has been estimated to be about four-fifths of the original amount purchased. A pencil slat makes six half-pencils. The same operation that grooves them to accommodate the lead also gives them their final form and the corresponding halves are identically made from another slat and glued together.

Carpenters' tools belong to this industry. They include commodities made almost entirely of wood such as spirit levels, rules, gauges, mallet heads, level boards, etc. Tools part wood and part metal like screwdrivers, chisels, gimlets, etc., have been grouped under the handle industry. White oak alone met the demand for gauges which require a hard dense light colored wood and from the price given only the best grades were used. In other States boxwood and sugar maple were also used but neither kind was reported in Pennsylvania. White ash and mahogany, because most stable when in place, answered for spirit levels and plumbs. In Connecticut and New Jersey, where a quantity of these commodities are made, cherry is an important wood and large quantities are used. Level boards were entirely of white pine, while for mallets a variety of woods is used. For carpenters' and tinners' mallets sugar maple answered while lignum-vitae, shipped from Mexico, and dogwood served for bung starters and coppersmiths' mallets. Heads of mauls used by sheet metal workers are made of black or sour gum and it is interesting to note that recently this wood has begun to replace sugar maple for this use. Its interlaced fiber, which prevents it from splitting, commends it, besides it is cheap and owing to the large dimensions the trees attain the bolts can readily be had in desired sizes.

In Pennsylvania, as in other states, boxwood is the principal rule material, both for mechanics' collapsible rules and office rulers. It is shipped to this country usually from Turkey or other Mediterranean countries, and owing to its hardness, light color, and stability, it is preferred to any other wood for this commodity. The same qualities commend it to the makers of draftsmen's scales, such as straight-edges, triangles, graduated and slide rules.

Camera makers report using three woods,—mahogany, cherry, and yellow poplar. The first two are the important ones, being strong, close-grained, and free from warping tendencies as well as ornamental. Yellow poplar is used in only relatively small amounts in this line of work and when so demanded goes principally into kits. Ebony was the highest priced wood shown in the table and was reported by the makers of drafting instruments.

Table 87.—Wood for Professional and Scientific Instruments, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Red cedar,	240,000	73.52	$52 00	$12.480	....	240,000
Yellow poplar,	16,400	5.02	73 78	1,210	....	16,400
Ash,	15,000	4.60	58 67	880	5,000	10,000
Black gum,	12,000	3.68	52 83	634	2,000	10,000
Cherry (black),	10,000	3.06	100 00	1,000	....	10,000
White oak,	10,000	3.06	55 00	550	....	10,000
Dogwood,	7,200	2.21	38 47	277	1,000	6,200
Mahogany,	5,118	1.57	169 21	866	....	5,118
Sugar pine,	5,000	1.53	70 00	350	....	5,000
Boxwood (West Indian),	2,300	.70	55 00	126	....	2,300
Lignum-vitae,	1,000	.31	120 00	120	....	1,000
White pine,	1,000	.31	90 00	90	....	1,000
Sugar maple,	930	.28	40 00	37	500	430
Ebony,	500	.15	260 00	130	....	500
Total,	326,448	100.00	$57 44	$18,750	8,500	317,948

PULLEYS AND CONVEYORS.

The commodities grouped in this industry are tackle blocks, belt pulleys, conveyors, and clutches, and thirteen kinds of wood are used for making them. Metal has to a large extent replaced wood in this line of manufacture, but studies similar to this in various states have shown that a considerable quantity of wood is still demanded for making them. For belt pulley rims the manufacturers in Pennsylvania call for birch, basswood, yellow poplar, cucumber, cottonwood, and butternut, and for the center arms, red oak, white oak, sugar maple, ash, and beech.

Tackle block material must be dense, hard, strong, tough, and most difficult to split. White ash, sugar maple, and a small amount of black gum are the woods reported in use in Pennsylvania though in other states elm is frequently used. Pulley blocks are of many types and sizes in order to meet a variety of uses. For example, those required on vessels, in building construction, in mines, on derricks and hoists by house painters, masons, carpenters, etc., range from a snatch block to the multiple pulley blocks. The latter is usually of the shoulder block type and designed for one or more sheaves. It is sometimes chambered out to receive a wheel in each compartment while at other times two or more wheels are placed side by side in a section. The old time block maker did much of the work by hand, but the improved machinery in recent years does the work with greater accuracy and in much less time. The lumber is ripped into dimensions the width of the block and the reciprocating saw then cuts the dimensions into shape, when they are passed on to be mortised. Often the wheel slats are cut by machinery and then the blocks are ready for the sheaves.

A small part of this industry consists in the manufacture of conveyors such as are used in factory elevators and warehouses to carry merchandise and grain. These require only a limited amount of wood for small parts and white oak and sugar maple are the species reported.

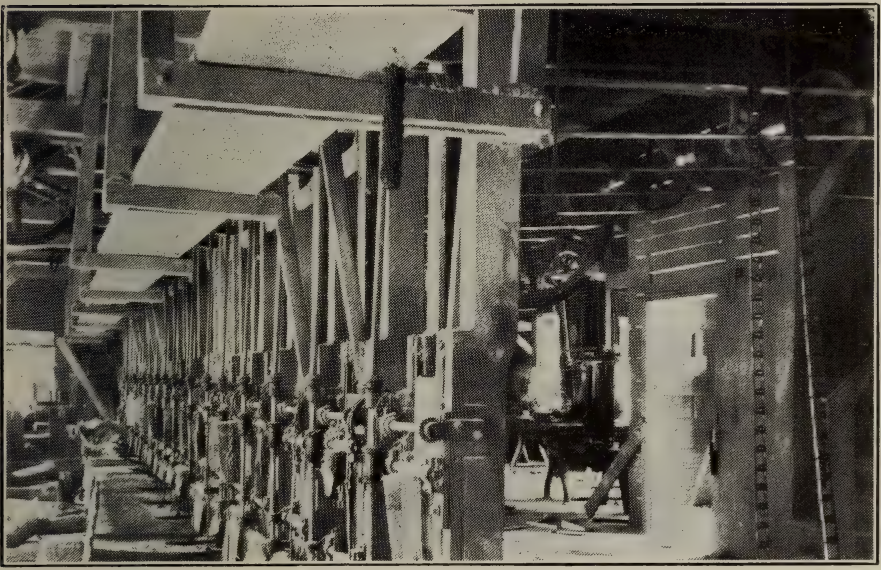

Fig. 30 —Interior of excelsior factory, showing billets in place in excelsior machines.

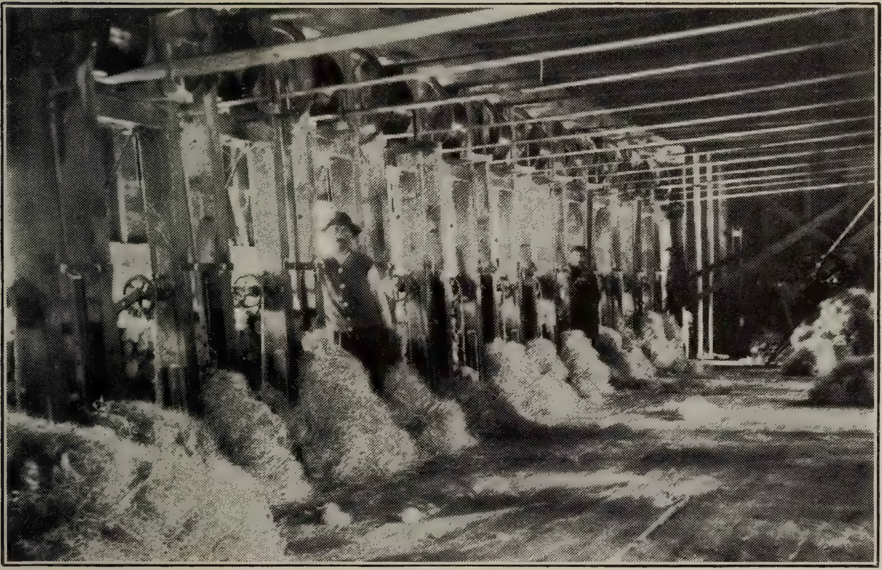

Fig. 31.—Finished excelsior ready for baling.

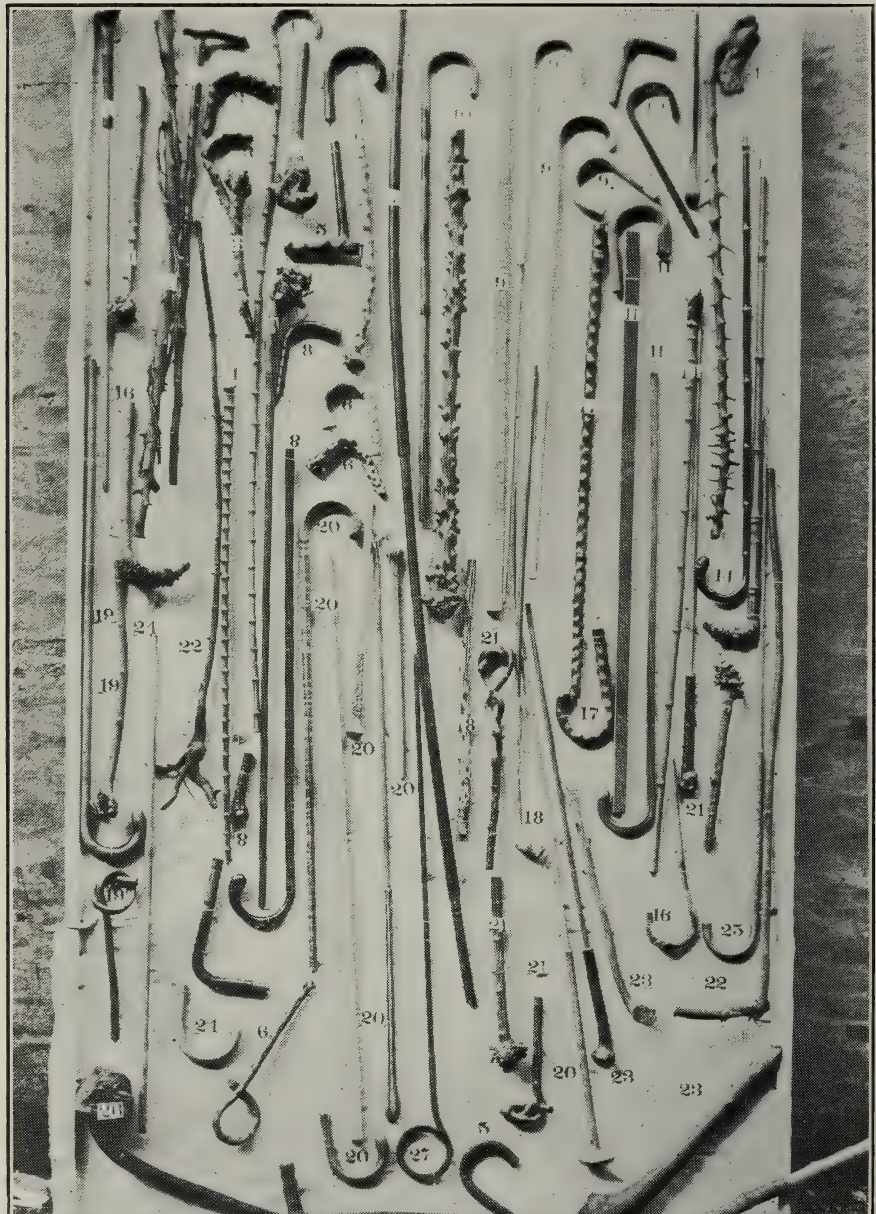

Fig. 32.—Whips, canes, and umbrella handles, and rough stock from which they are manufactured.

DESCRIPTION OF FIGURE 32.

1. Butt cut seedling and umbrella handle—sweet birch.
2. Cut of seedling and cane—osage orange.
3. Butt-cut seedlings, two umbrella handles—boxwood.
4. Whangee cuts, one bent ready to be cut into cane length.
5. Three designs of weichsel umbrella handles.
6. Butt-cut of furze, 1 parasol and 2 umbrella handles.
7. Malacca (rattan) cut and cane.
8. Butt cut seedling, umbrella handle and cane—partridge.
9. Rough sawn billet, parasol handle and cane—holly.
10. Madagascar cut—natural cane ready for ferrule.
11. Rough sawn billet, umbrella handle and cane—applewood.
12. Two parasol and one umbrella handle—ebony.
13. But-cut seedling of haw (black thorn).
14. Cut of bamboo and cane.
15. Corra cane with rice-root handle.
16. Rice-root from which handle of 15 was made.
17. Cut of Congo and umbrella handle.
18. Cut of Scotch thistle and parasol handle.
19. Butt-cut seedling, umbrella handle and cane—dogwood.
20. Rough sawn billet, cane, umbrella and 4 parasol handle—sugar maple.
21. Butt-cut seedling, 4 umbrella handles—French oak.
22. Butt-cut seedling—black ash.
23. Two butt-cut seedlings and umbrella handle—hickory.
24. Cut of lancewood and umbrella handle.
25. Morillo cherry (sweet cherry) parasol handle.
26. Congo root for umbrella handle.
27. Red oak (Jersey)—parasol handle.

Cuts of white thorn and bamboo unnumbered, at bottom of illustration

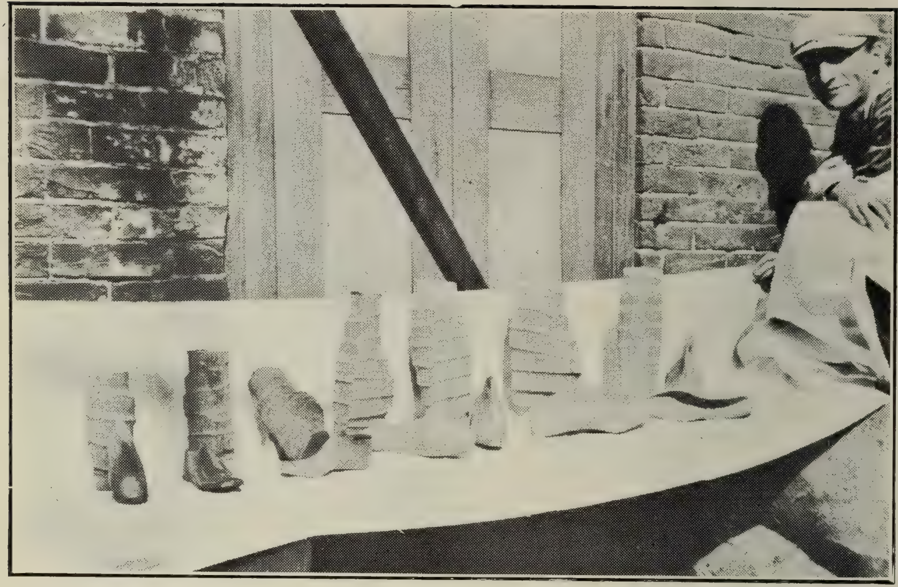

Fig. 33.—Manufacturer of shoe lasts. Roughly cut billets and the finished lasts turned from them.

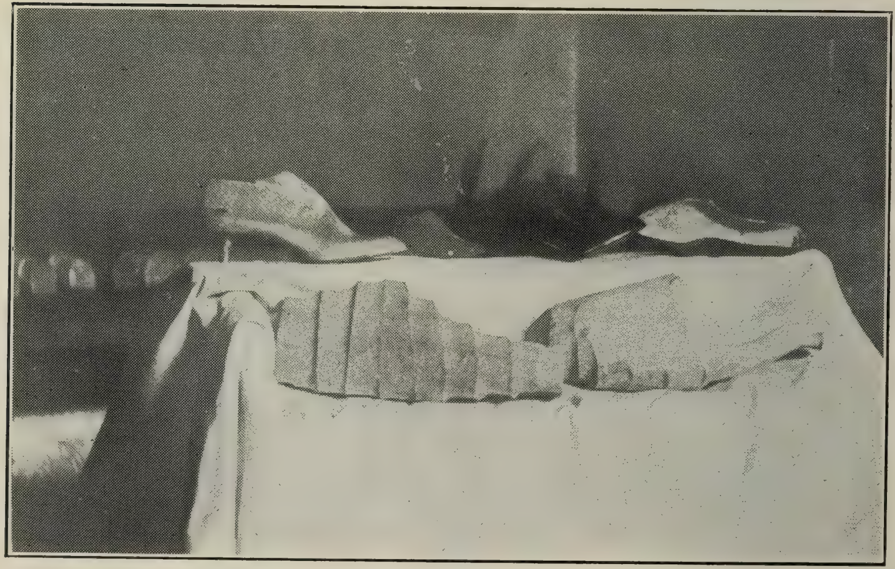

Fig. 34.—Evolution of a shoe last.

Table 88.—Wood for Pulleys and Conveyors, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Yellow poplar,	80,000	27.16	$28 75	$2,300	10,000	70,000
Sugar maple,	68,000	23.09	43 68	2,970	66,000	2,000
Basswood,	40,000	13.58	20 00	800	40,000	....
Ash,	15,000	5.09	30 00	450	7,000	8,000
Beech,	15,000	5.09	20 00	300	15,000	....
Black gum,	14,000	4.75	33 71	472	....	14,000
White oak,	10,500	3.56	30 95	325	10,500	....
Birch,	10,000	3.40	20 00	200	10,000	....
Red oak,	10,000	3.40	25 00	250	10,000	....
Red and silver maple,	10,000	3.40	14 00	140	10,000	....
Cucumber,	10,000	3.40	18 00	180	10,000	....
Butternut,	10,000	3.40	20 00	200	10,000	....
Cottonwood,	2,000	.68	21 00	42	2,000	....
Total,	294,500	100.00	$29 30	$8,629	200,500	94,000

BOOT AND SHOE FINDINGS.

Nearly all shoes in the United States are made over wooden lasts and, therefore, the manufacture of these lasts as well as other shoe findings is an important enterprise. In comparison with the quantity of woods consumed in other states, particularly Massachusetts, Michigan, New Hampshire, and New York, this industry in Pennsylvania is relatively small; but because of the substantial well equipped establishments, of the skilled labor employed, and in the high grade of products manufactured, it is of considerable industrial importance. Lasts, shoe forms, and wood soles are the commodities to which the statistics in Table 89 refer.

Lasts are made from sugar maple and persimmon because they possess the essential qualities of hardness, density, capacity for smooth finish, and permanence in final shape. No other domestic woods have been found equally suitable. The former goes into lasts, all sizes and kinds, both for leather and rubber shoes, and the latter for the better grades of children's and misses' sizes. Considering the great number of shoes made in this country, comparatively few lasts are needed as many pairs are made over the same pattern. The wear on the last is considerable and it can be used steadily for no longer than twelve to fifteen months. For that reason only the high grade select wood is required.

There are two distinct divisions of the last industry,—the manufacture of the last block from bolts, and the manufacture of the finished last from the rough turned blocks. The industry in Pennsylvania covers only the manufacture of the latter and the fact that no last and filler blocks were found being made in the State, though maple and basswood are commonly cut in Pennsylvania, explains the fact that the entire amount of wood used by the last makers was reported as coming from other states.

Last block manufacture entails various difficulties in kiln-drying and many who have started the business have failed. Those who have mastered the obstacles and acquired efficient processes of seasoning manufacture on a large scale and therefore reduce the number of block factories many times below the number of the last makers. Last blocks are split from bolts winter cut and then rough turned to various sizes on machines usually of special design. The seasoning begins after the blocks are turned. First, they are air-dried about twelve months after they are placed on racks under sheds. The seasoning is completed by means of dry kilns and for this a period, approximately three months, is required when the block is ready to send to the last maker.

Shoe trees, to be inserted into shoes to hold the shape, are an important part of this industry but none are manufactured in Pennsylvania. Formerly they were made solid of wood and were expensive. The best are still so made; but recently, by the introduction of a combination tree of steel bands and wood blocks, it has been made possible to make them to sell at a nominal cost.

Basswood is used as exclusively for forms or fillers as is sugar maple for lasts. Forms are turned similarly from rough turned blocks. They are used to maintain the natural shape of the shoe in samples displayed in show cases and when being handled by traveling salesmen. They fit the shoes perfectly and give an effect similar to the appearance of the shoe on the foot. Fillers should be light in weight to save cost in transportation in salesmen's trunks. To reduce weight to the minimum many are hollowed, and basswood being soft, easily worked, light, and sufficiently tough, holding its shape well, is the most practical wood to use. The growing high cost of basswood has made a demand for a suitable substitute at a lower price but as yet none has been found.

Clog or wooden soled shoes have leather tops and are used by people working in wet and cold places, such as breweries, tanneries, creameries, mines, dye works, fish canneries, slaughter houses, paper mills, also in foundries and metal works, and by others who desire a very durable shoe at a reasonable price. High grades of yellow poplar and basswood are the materials demanded for clog soles in Pennsylvania, but in Illinois, Michigan, and Kentucky, beech, maple, and basswood in the order named contributed the material.

Table 89.—Wood for Boot and Shoe Findings, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Sugar maple, ...	100,500	37.92	$55 86	$5,614	....	100,500
Persimmon, ...	99,000	37.36	59 19	5,860	....	99,000
Basswood, ...	35,500	13.40	50 73	1,801	18,000	17,500
Yellow poplar, ...	30,000	11.32	56 67	1,700	....	30,000
Total, ...	265,000	100.00	$56 51	$14,975	18,000	247,000

SMOKING PIPES.

Pennsylvania leads all other states in the consumption of wood for smoking pipes. Five woods supply the raw material for this line of manufacture; two of them are foreign species. Applewood leads the list as to amount, and is the only wood reported cut in the State. The best grades of pipes are made from French briar, ebony, and rosewood, but the last named was not reported in Pennsylvania. The sapwood of sweet or cherry birch and red gum is used for cheap pipes, the former to imitate calabash and the latter rosewood. Olivewood pipes resemble meerschaum when finished.

Table 90.—Wood for Tobacco Pipes, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Applewood,	121,435	53.38	$52 42	$6,372	61,435	60,000
French briar,	81,800	35.95	351 34	28,740	....	81,800
Red gum,	12,000	5.27	50 00	600	....	12,000
Ebony,	9,800	4.31	183 67	1,800	....	9,800
Birch,	2,000	.88	50 00	100	....	2,000
Olive wood,	480	.21	81 25	39	....	480
Total,	227,515	100.00	$165 49	$37,651	61,435	166,080

SPORTING AND ATHLETIC GOODS.

Ash, on account of its strength and convenient weight, is probably the premier wood for baseball bats. The entire amount listed in Table 91 went for this use, and most of it was purchased in the form of squares, usually 3 inches by 3 inches by 38 inches long. In other states bat maufacturers used several woods, the principal ones other than ash being hickory, willow, beech, ironwood, and maple. Though all of these are trees indigenous to Pennsylvania, and the wood easily obtained, the manufacturers in this State did not report the use of any.

Twice as much beech was used for game traps as any other wood and its strength and density especially favor it for this purpose. Hard maple, its chief competitor, with small quantities of ash and birch supplied the rest of the material, purchased in the form of surfaced lumber. All used was cut in the State.

Sugar maple, hard, tough, close grained, easily turned, has proved the best qualified wood for duck and ten pins. The quantity used in Pennsylvania is somewhat disappointing considering the large quantity of pins sold. Information was secured of a large number of duck pin squares being cut in the State, but they were shipped elsewhere to be manufactured and doubtless are sent back to be sold in the finished product. Lignum-vitae answered for bowling balls and, though a composition ball resembling hard rubber is being more generally used, the best bowlers prefer the wooden ball. Lignum-vitae is the highest priced wood shown in the table and is bought in the form of bolts shipped from the West Indies. No domestic wood possesses the combined qualities for balls equal to lignum-vitae. It is very heavy, hard, dense, strong, and keeps its shape. Dogwood is the nearest approach and is used to a limited extent but is not durable. None was reported in Pennsylvania.

Sugar maple and longleaf pine are the most used woods for bowling alleys. The latter wood, edge grain and best grade, is used for the bed of the alley, and the former for the approach and pin spot end and also for the return track. Spruce or longleaf pine are the best for the gutters, and for the buffer frames and sheathing shortleaf pine and hemlock were called for.

Pool and billiard tables and shuffle boards account for the rest of the woods not mentioned above which are listed in the table. Chestnut and yellow poplar answers for frames of pool and billiard tables, red oak, white oak, ash, and sugar maple for the legs and also for sides and bodies. Cherry went into triangles for setting pool balls and maple was the only wood for cues.

Table 91.—Wood for Sporting and Athletic Goods, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Sugar maple,	97,500	45.32	$36 14	$3,524	47,500	50,000
White oak,	41,500	19.29	38 27	1,588	31,000	10,500
Ash,	30,000	13.94	66 83	2,005	30,000	....
Beech,	20,000	9.30	17 25	345	20,000	....
Cottonwood,	10,000	4.65	32 00	320	....	10,000
Chestnut,	10,000	4.65	33 00	330	5,000	5,000
Yellow poplar,	5,000	2.32	28 00	140	5,000	....
Lignum-vitae,	550	.25	118 18	65	....	550
Red oak,	500	.23	35 00	17	500	....
Cherry (black),	100	.05	46 00	5	100	....
Total,	215,150	100.00	$38 76	$8,339	139,100	76,050

SADDLES AND HARNESS.

Hames are the principal commodity included in the following table. They require a tough, strong, close wood. Ash and white oak furnished the largest portion of the supply of raw material in Pennsylvania, which was purchased in the form of squares of various sizes, the principal sizes being 2½ inches by 2½ inches, 30 inches long, and 2¾ inches by 2¾ inches, 32 inches long. White ash was the favorite as to quantity. Black ash and hickory, though used, contributed but small amounts. Pennsylvania is the first state in which hickory has been reported by hame manufacturers though it has for a long time been used by farmers for hand-made hames. According to reports from factories in other states, ironwood, sugar maple, beech, white elm, and red oak are suitable hame materials though their use was not reported in large quantities.

White ash was the only wood called for in Pennsylvania for making saddle trees, which is the only product except hames classed under this heading. From other similar state reports, ash, though adaptable, is an uninportant wood for this use. The kinds most used named in the order of quantity and selected because of the quality of toughness with requisite weight are: White elm, cottonwood, sycamore, soft maple, white oak, ash, hackberry, and basswood.

Table 92.—Wood for Saddles and Harness, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Ash,	100,000	53.19	$44 80	$4,480	76,000	24,000
White oak,	70,000	37.23	71 43	5,000	60,000	10,000
Hickory,	10,000	5.32	60 00	600	....	10,000
Red oak,	8,000	4.26	40 00	320	....	8,000
Total,	188,000	100.00	$55 32	$10,400	136,000	52,000

GATES AND FENCING.

Table 93 lists seven woods used in Pennsylvania for fence pickets and gates, both farm gates and those used for the enclosure of front yards and lawns. White cedar, shipped in from the Carolinas, stands first as to quantity and in no other industry was it the principal wood. Its durability in exposed situations especially commends it for this use. Spruce is listed in the table in large quantities and the fact that it was preferred to several State-grown woods that could probably have been obtained cheaper and known to be more durable, is worthy of note. The durable properties of cypress, together with its strength, favor it also as an excellent wood for gate and fencing material. That cypress is demanded for the best lines of work of this character is seen from the fact that it is the only wood reported by railroads for crossing gates. In the lower grades it is popular for lawn fence pickets, for which use it serves with chestnut and white pine. Stubs, the wooden parts of patent woven wire fencing, called for chestnut and white cedar. Though white cedar was used in larger quantities, yet chestnut, because it is cheaper and at the same time possesses lasting qualities for outdoor uses, is destined to grow in favor for this purpose.

Table 93.—Wood for Gates and Fencing, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Southern white cedar,	100,000	61.98	$20 00	$2,000	....	100,000
Spruce,	36,000	22.31	25 00	900	....	36,000
Chestnut,	11,500	7.13	25 39	292	6,500	....
White pine,	5,000	3.10	22 00	110	5,000	....
Yellow poplar,	5,000	3.10	26 00	130	5,000	....
Cypress (bald),	3,840	2.38	55 00	211	....	3,840
Total,	161,340	100.00	$22 58	$3,643	16,500	144,840

CLOCK CASES.

In the quantity of wood consumed, the manufacture of clock cases in Pennsylvania is one of the minor industries. However, since wood is only one of a number of materials required, it is not a fair basis for comparison. Clock makers report the use of lumber for mantel and wall clocks, and to a limited extent for large hall and grandfather clocks. Mahogany is the principal wood used and represents over 50 per cent. of the total. This is the only industry in which an imported wood leads the list of species. Next to mahogany, the oaks were in the largest demand for the exterior work of wall clocks finished natural or darkened by fumes or stain to produce the mission effects.

The backs of cases of all kinds and the bottoms of mantel clocks are not visible and are therefore made of cheaper wood. Yellow poplar and basswood met this demand because they hold their shape and are easy to work and nail. Yellow poplar is also called on to a limited extent for the base or backing of enameled work. The art of enameling wood has made rapid progress of late years and imitations are made not only to resemble foreign woods but also marble and other materials.

Veneer takes a prominent place in this industry, both as a finish and as layers in 3-ply built-up stock used in making clock cases. The appearance of chestnut and yellow poplar in the table is accounted for in this form. In regard to the price shown for red gum, it should be noted that it was used for finish or exterior work and as it is frequently found beautifully modeled with figure and color similar to Circassian walnut it furnishes a substitute for that wood for finish.

Table 94.—Wood for Clocks, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Mahogany,	43,000	30.83	$103 84	$4,465	....	43,000
Yellow poplar,	35,000	25.09	33 57	1,175	....	35,000
Black walnut,	21,000	15.05	50 95	1,070	21,000	....
White oak,	13,500	9.68	74 30	1,003	....	13,500
Red gum,	10,000	7.17	60 00	600	....	10,000
Chestnut,	5,000	3.58	30 00	150	5,000	....
Basswood,	5,000	3.58	60 00	300	....	5,000
Birch,	4,000	2.87	45 00	180	....	4,000
Red oak,	3,000	2.15	45 00	135	....	3,000
Total,	139,500	100.00	$65 08	$9,078	26,000	113,500

ROLLERS AND POLES.

Window shade rollers belong to this industry but none are manufactured in Pennsylvania, though sawmills cutting white pine were found furnishing large quantities of material in the desired form to the New York shade roller makers. Curtain poles and brackets, rug and drugget poles, and awning rollers are the articles to which the statistics in Table 95 refer. Basswood is the leading wood and it went entirely into curtain poles. It serves well for this use, first, because it is so easily worked, and second, the ease and permanence with which it takes paint and stain allows it to be finished to imitate expensive hardwoods like walnut, mahogany, and oak. Hard maple, sweet birch, white oak, and white ash are other important curtain pole woods and the ones reported mainly for curtain pole fixtures and brackets.

Rug and drugget pole manufacturers called principally for black gum, but beech, basswood, and yellow poplar met part of the demand. Awning rollers require a heavy wood. Sugar maple, hickory, beech, and black gum were the ones reported. The two former, being expensive, were used in small quantities only. Black gum is practically a new wood for this use but the demand is increasing owing to its being one of the cheapest hardwoods with the requisite weight, strength, and adaptability for being turned. Redwood was the only wood reported for shade hangers.

Table 95.—Wood for Rollers and Curtain Poles, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
Basswood,	37,500	29.86	$20 00	$750	37,500	....
Sugar maple,	27,425	21.84	16 59	455	27,000	425
White oak,	19,000	15.13	16 63	316	19,000	....
Beech,	12,000	9.56	14 00	168	12,000	....
Birch,	12,000	9.56	14 00	168	12,000	....
Ash,	6,150	4.90	32 68	201	5,000	1,150
Black gum,	6,000	4.78	20 00	120	....	6,000
Hickory,	2,500	1.99	60 00	150	2,500	....
Redwood,	2,000	1.59	45 00	90	....	2,000
Yellow poplar,	1,000	.79	65 00	65	....	1,000
Total,	125,575	100.00	$19 77	$2,483	115,000	10,575

MANUAL TRAINING PRACTICE.

Improved systems of public school education today endeavor to give not only a thorough grounding in the usual elementary subjects but also offer opportunities to acquire the fundamentals of various artisan trades by methods of practical work in the laboratory, the shop, or the field. These specialized schools or departments are known as "Manual Training" and in connection with the excellent system of public education in Pennsylvania there has been established a large number of them throughout the State. They offer instruction in a diversity of practical courses. Important among these is wood craft. Shops equipped with tools of all kinds and with wood-working machinery afford training in the making of many kinds of commodities and an insight into all lines and processes of wood-working. Woods that are soft and possess properties to work easily are naturally the kinds in greatest demand. That white pine, yellow poplar, and basswood head the list in Table 96, therefore, is not surprising, but that so small amounts of yellow pine and hemlock are employed, these being the cheapest woods, is interesting, especially as these woods are important in many wood manufacturing industries. If both the red and white oaks had been compiled under one heading, oak, this wood would have been first in the table. Of the twenty species used, mahogany is the highest priced and beech the lowest.

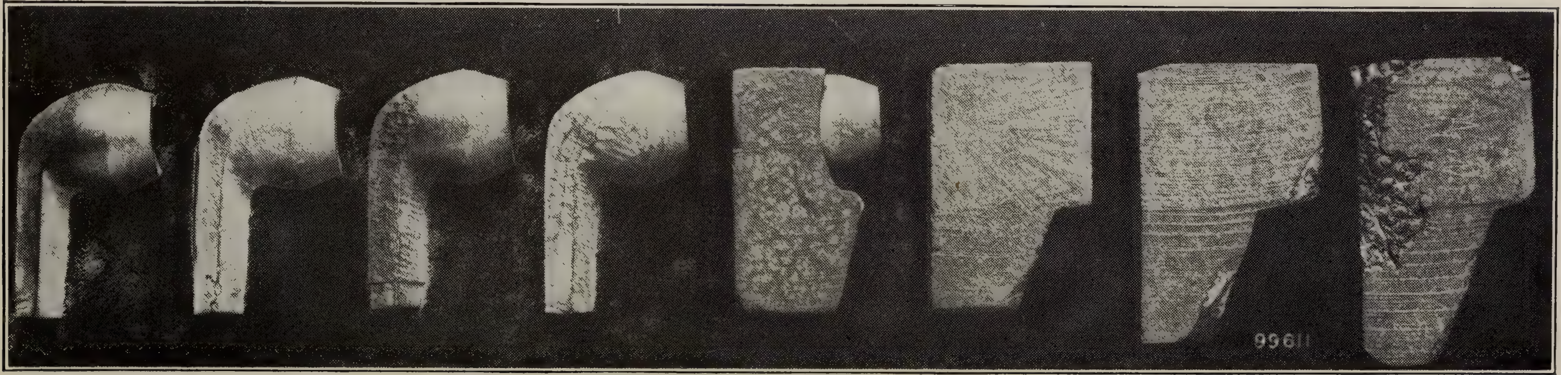

Fig. 35.—Evolution of a briar pipe.

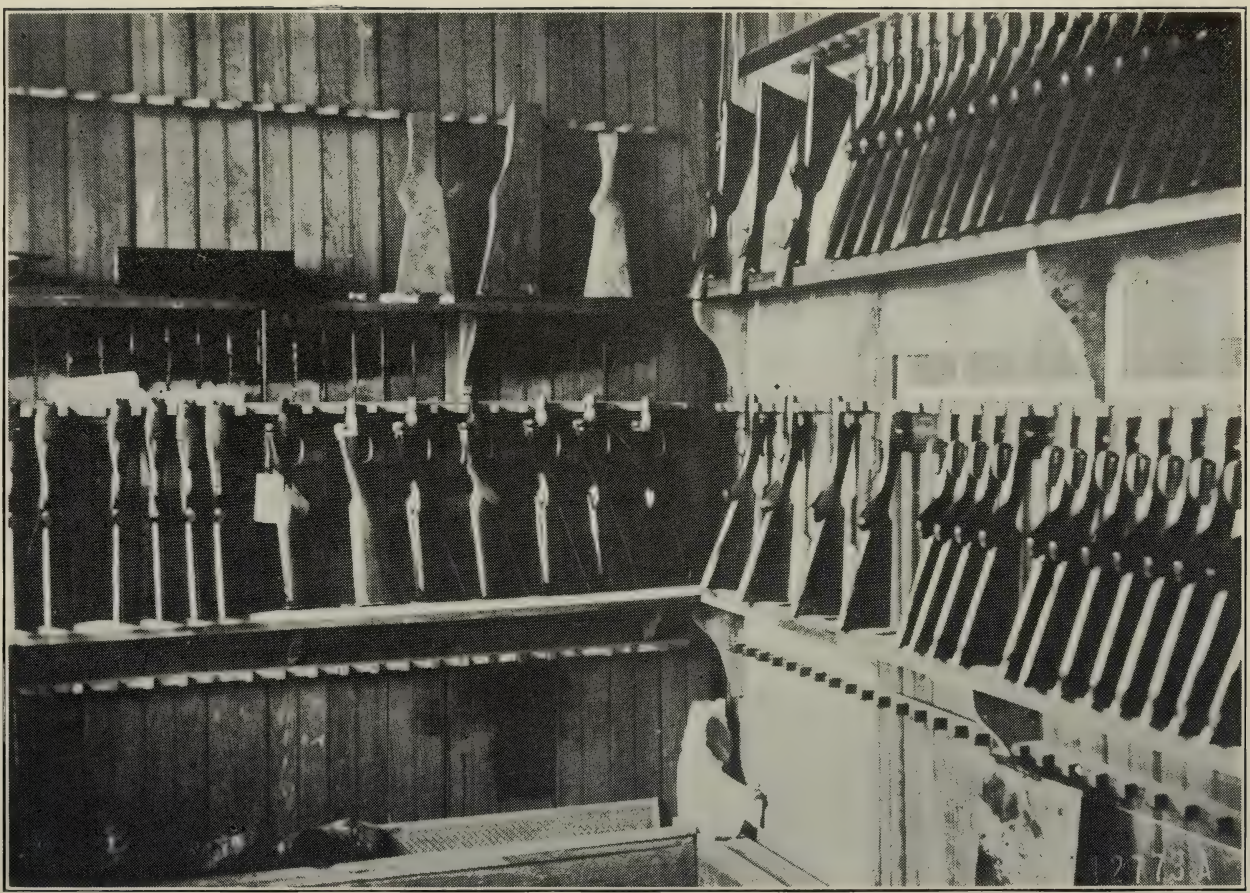

Fig. 36.—Evolution of a gun stock and a number of finished stocks ready for market, made of black and Circassian walnut.

Table 96.—Wood for Manual Training Practice, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White pine,	21,575	22.49	$72 35	$1.561	8,675	12,900
Yellow poplar,	16,250	16.94	66 95	1,088	9,550	6,700
Basswood,	14,400	15.01	43 06	590	7,650	6,750
Red oak,	13,070	13.62	72 61	949	9,070	4,000
White oak,	10,500	10.94	83 81	881	4,950	5,550
Chestnut,	7,000	7.30	64 14	448	5,000	2,000
Sugar maple,	3,350	3.49	50 45	169	3,050	300
Cherry (black),	1,850	1.93	55.68	103	1,850	....
Cypress (bald),	1,750	1.82	63 43	111	....	1,750
Ash,	1,100	1.15	70 91	78	300	800
Hickory,	934	.97	70.66	64	234	700
Black walnut,	850	.89	87 06	77	650	200
Mahogany,	750	.78	134 07	101	....	750
Beech,	600	.62	28 33	17	600	....
Sugar pine,	500	.52	80 00	40	....	500
Red gum,	470	.49	72 34	34	....	470
Red cedar,	400	.42	97.50	39	....	400
Hemlock,	262	.27	34 35	9	262	....
Shortleaf pine,	250	.26	40 00	10	....	250
Redwood,	50	.05	60 00	3	....	50
Dogwood,	34	.04	90 00	3	34	....
Total,	95,945	100.00	$66 44	$6,375	51,875	44,070

MISCELLANEOUS.

In soliciting information from the various manufacturers concerning the extent of their operations in the consumption of wood, the Forest Service and the Pennsylvania Department of Forestry made assurance that the data would be treated confidentially and not used in the report so as to reveal the identity of the establishments furnishing it. Whenever, therefore, fewer than three factories making similar commodities were entitled to be grouped as an industry, rather than discard the information from the report it was placed under the head "Miscellaneous."

The nearly seven and a half million feet shown as the total of the table includes considerably over five million of State-grown white pine for matches, more than 100 M feet of beech cut in the State for brewer chips, used in breweries to clarify beer, nearly 200 M feet of white ash, Douglas fir, soft maple, and beech for flag poles and shafts, and nearly one-half that amount consisting of spruce, hemlock, and yellow pine for tent poles. Small quantities of red cedar were used for oil barrel faucets, and black walnut and Circassian walnut for stocks and fore-ends of both fire-arms and of air rifles.

Table 97.—Wood for Miscellaneous, year ending June, 1912.

Kind of Wood.	Quantity.		Average cost per 1,000 ft. at factory.	Total cost f. o. b. factory.	Grown in Pennsylvania.	Grown Out of Pennsylvania.
	Feet b. m.	Per cent.			Feet b. m.	Feet b. m.
White pine,	7,002,000	94.41	$16 00	$182,070	7,002,000	....
Beech,	175,003	2.36	14 86	2,600	175,003	....
Red and silver maple,	50,000	.67	14 00	700	50,000	....
Ash,	50,000	.67	25 00	1,250	50,000	....
Black walnut,	34.200	.46	71 81	2,456	10,200	24,000
Birch,	25,000	.34	14 00	350	25,000	....
Loblolly pine,	17,000	.23	30 00	510	....	17,000
Douglas fir,	14,400	.20	50 00	720	....	14,400
Hemlock,	12,250	.17	28 16	345	10,000	2,250
Sugar maple,	11,500	.16	20 00	235	11,500	....
Spruce,	10,000	.13	20 00	200	....	10,000
Circassian walnut,	10,000	.13	183 00	1,830	....	10,000
Red cedar,	5,000	.07	40 00	200	....	5,000
Total,	7,416,353	100.00	$26 09	$193,466	7,333,703	82,650

PART III.

THE USES OF WOOD BY PENNSYLVANIA MANUFACTURERS.

The following list indicates the various uses of wood reported by Pennsylvania manufacturers. The collation comprises over 6,000 separate commodities, and is probably the most complete statement of this kind ever presented.

APPLEWOOD.

Handles, handsaw
Pipes, smoking
Screws, bookbinders

ASH, BLACK.

Baskets
Bats, baseball
Beams, plow
Bodies, sleigh
Boxes, comb
Boxes, knife
Boxes, salt
Boxes, tin plate
Box shooks
Cabinets, kitchen
Cabs, locomotive
Chairs, kitchen
Chests, ice
Commodes, interior
Cooperage stock
Covers, butter pail
Crating
Finish, boot
Frames, automobile bodies
Frames, carriage bodies
Frames, wagon bodies
Handles, garden trowel
Handles, hammer
Handles, hand drill
Handles, hoe
Handes, lawn mower
Handles, paint brush
Handles, rake
Handles, wheel hoe
Hoppers, vegetable
Moulding, picture
Pails, candy
Pews, church
Poles, pike
Poles, plow
Refrigerators
Seats, auto
Seats, carriage
Sides, cheese box
Slats, bed
Slats, trunk
Sleds, coaster
Tops, cheese box
Tubs, butter
Tubs, lard
Washboards, laundry
Wood pulleys

ASH, WHITE.

Bottoms, automobile seat
Automobile bodies
Axle beds, buggy
Axle beds, perch spring wagon
Axle beds, surrey
Back boards, piano
Backing, cases
Backs, automobile seats
Backs, hair brush
Backs, nail brush
Backs, scrubbing brush
Balusters (stair)
Base blocks, house interior trim
Base corners, house interior trim
Base board, house interior trim
Base moulding, house interior trim
Baskets, split
Bats, baseball
Batters, dumb waiter
Beams, dining room ceiling
Beams (elevator)
Beds, light delivery wagons
Belt panel, light delivery wagon bodies
Benches, mess (boat)
Benches, piano
Blocks, brake
Blocks, brush
Blocks, pulley
Blocks, tackle
Boards, drain
Bodies, automobile
Bodies, cart
Bodies, wheelbarrow
Book racks
Bottoms, washing machines
Bows, automobile
Bows, buggy top
Bows, carriage top
Bows, hay bed farm wagons
Bows, wagon tops
Boxes, creamery shipping
Boxes, roller sign, (electric cars)
Brackets, plate rail
Brackets, stair
Brushes
Bushel crates
Cabinets, filing, exterior
Cabinets, printer
Cabinets, special work
Cabinets, typewriter
Cabins, interior, river craft
Cabins, interior, ships
Cabins, interior, yachts
Cabs, locomotive
Carpet strip, house interior trim
Cars, elevator
Cases, binnacle
Cases, ship chart
Cases, type
Casing, controller box, electric cars
Casing, door
Casing, pipe organ
Casing, window
Chair arms, railway cars
Chair bottoms
Chair rail, house interior trim
Churn parts
Cleats, dumb waiter
Coaming, motor boat
Colonnades, house interior trim
Consoles
Corner blocks, house interior trim
Corner posts, light delivery wagons
Costumers
Counter tops, bar room
Covers, hatchway (ship)
Covers, switch boxes (electric cars)
Cues, billiard
Cupboard doors, railway cars
Decking, canoe
Doors
Doors, dumb waiter shaft
Doors, folding
Doors, locker (boat and ship)
Doors, sliding
Drain boards
Drop gate, light delivery wagon bodies
Dumb waiters
Dumb waiter parts
Dust guards (railway passenger cars)
Elevators, grain
Eveners
Facing, window partition (electric cars)
Felloes, heavy vehicle wheels
Felloes, light delivery wagons
Fifth wheel bars, light delivery wagons
Fifth wheel circles, light delivery wagons
Fifth wheel spools, light delivery wagons
Fillers, Scotch hame
Fillet, house interior trim
Finish, interior engine cab
Finish, yacht cabins
Fixtures, office, exterior
Flat battens, house interior trim
Flooring
Flooring, freight car platform scales
Flooring, freight elevators
Flooring, (passenger elevator cars)
Frames, automobile bodies
Frames, bob sleds
Frames, chair
Frames, coal screens
Frames (elevator cars)
Frames, gravel screens
Frames, sand shaking screens
Frames, tennis racket
Framework, automobile cushion
Front panels, light delivery wagons
Grilles (ship and boat cabins)
Guide posts, dumb waiter
Handles, bottom pick
Handles, brush
Handles, clay pick
Handles, coal pick
Handles, collier shovel
Handles, cultivator
Handles, garden hoe
Handles, garden rake
Handles, hay knife
Handles, jack screw

ASH, WHITE—Continued.

Handles, lawn mower
Handles, lawn rake
Handles, manure fork
Handles, mining pick
Handles, paint brushes
Handles, piano
Handles, pick
Handles, pitch fork
Handles, scoop
Handles, shovel
Handles, spade
Handles, special brushes
Handles, varnish brushes
Hay beds, farm wagon
Hay bed blocks, farm wagon
Head blocks, house interior trim
Head casing, house interior trim
Heading, nail keg
Heading, slack cooperage
Heel board, light delivery wagons
Hind spring bars, light delivery wagons
Horses, rocking
Hounds, light delivery wagon
Hubs, wheelbarrow
Key bottoms, piano
Keels, motor boat
Knees, canal boat
Knees, river craft
Knees, ship
Knees, yacht
Knobs, door
Ladders, hay
Ladders, river craft
Ladders, ship
Ladders, step
Lagging, refrigerator machine cylinders
Lagging
Lath
Legs, billiard tables
Lining, cases
Lower head blocks, light delivery wagons
Lower panels, light delivery wagon bodies
Jacks, wagon
Jambs, door
Interior finish
Interior finish, electric cars
Interior finish, house
Interior finish, (railway cars)
Interior finish, traction engine cabs
Mantels
Milk counters, dairymans
Mirror doors, house
Moulding, automobile
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove, house interior trim
Moulding, crown, house construction
Moulding, picture
Moulding, plaster, house interior trim
Moulding, quarter round, house interior trim
Moulding, spring cove, house construction
Neck yokes
Newel posts, angle
Newel posts, starting
Novelties
Nosing, house interior trim
Oars, row boat
Panels, automobile bodies
Panels, ceiling (railway cars)
Panels, door
Panels, wagon bodies
Panels, windows, railway cars
Panel strips, interior house trim
Panel wainscoting, railway cars
Paper pulp
Parts, flour mill machinery
Piano cases, veneer
Pilasters, piano
Pillars, light delivery wagon
Pilot wheels, river craft
Pilot wheels, ship
Pilot wheels, yacht
Planks, fish
Planks, steak
Plate rail, dining room
Pole futchels, light delivery wagons
Posts, chair
Posts, piano
Posts, wagon
Posts, warehouse trucks
Push carts (bodies)
Racks, display
Racks, magazine
Rails, doors
Rails, guide (dumb waiter)
Rails, river craft
Rails, ship
Rails, stair
Rails, yacht
Reaches, buggy
Reaches, farm wagon
Reaches, lumber wagon
Reaches, perch spring wagon
Reaches, surrey
Reaches, wagon
Rear end posts, light delivery wagons
Refrigerators
Refrigerators, exterior
Ribs, boat
Ribs, canoe
Ribs, motor boat
Rims, automobile wheels
Rims, carriage wheels
Risers, stair
Rockers, chair
Rollers
Rollers, caster
Rosettes, wall (stairway)
Rounds, ladder
Rounds, plow
Rungs, ladder
Runners, bob sled
Running boards, automobile
Saddletrees
Sash, electric cars
Sash, railway cars
Seat boards, light delivery wagons
Seat frames, canoe
Shackle bars, light delivery wagons
Shafts, light vehicles
Shelves, dumb waiter
Shoe rails (stair)
Showcases, exterior
Sides, billiard tables
Sides, push cart
Sides, truck
Side pillars, light delivery wagons
Sides, wagon bodies
Side futchels, light delivery wagons
Side slats, light delivery wagons
Signal blades, railroad
Sills, automobile
Sills, buggy
Sills, buggy bodies
Sills, carriage
Sills, carriage bodies
Sills, delivery wagons
Sills, light delivery wagons
Sills, inside window (electric cars)
Sills, window, inside (railway cars)
Slats (automobile tops)
Slats, bed
Slats, trunk
Slats, wagon top
Sleds
Sleds, frame work
Sleds, toy
Splinter bars, light delivery wagons
Spokes, automobile wheels
Spokes, heavy vehicle wheels
Spokes, light delivery wagons
Spokes, push cart wheels
Spring yokes, light delivery wagons
Staffs, flag
Stakes, log cars
Stands, umbrella
Staves, butter pail
Staves, slack cooperage
Staves, tight cooperage
Staves, washing machine
Stay bars, light delivery wagons
Stays, boat
Stems, canoe
Stems, motor boat
Stems, river craft
Stems, ships
Stems, yachts
Stern posts, motor boat
Stiles, door
Stops, door, house interior trim
Stops, drawer
Stretchers, curtain
String boards (stair)
Strips (elevator cars)
Strips, guide (elevator)
Swing cleats, curtin pole
Tables, sewing
Tables, telephone
Tillers, canal boat
Tillers, river craft
Top rails, light delivery wagon bodies
Top slats, light delivery wagon bodies
Tops, washing machines
Treads, stair
Tripods, camera
Upper head blocks, light delivery wagon
Veneer
Wainscot rail, house interior trim
Wainscoting, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

ASPEN.

Excelsior

BASSWOOD.

Altars, church
Animals, toy
Astragals, folding door
Astragals, sliding door
Backing, mirror
Backs, buffets
Backs, bureaus
Backs, chiffoniers
Backs, mirror
Baskets, split
Base blocks, house interior trim
Base boards, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Beams, dining room ceiling
Bedsteads, hidden work
Bellows, organ
Bellows frames, organ
Binding strips, school blackboard
Blinds, window
Blocks, brake
Blocks, brush
Blocks, tassel
Blowers, organ

BASSWOOD—Continued.

Blowers, player piano
Boards, ironing
Boards, pastry
Boards, potato chip
Boards, potato peeler
Boards, skirt
Boards, slaw
Boats, toy
Bodies, baby carriage
Bottom panels, piano cases
Bottom rails, sash
Bottoms, buffets
Bottoms, case
Bottoms, chiffoner
Bottoms, dressers
Bottoms, grape basket
Boxes, bottle
Boxes, candy
Boxes, knife
Boxes, novelty
Boxes, packing
Boxes, shirtwaist
Boxes, trunk
Boxes, type
Brackets, plate rail
Brake blocks, mine pit wagon
Bushel crates
Capping, sink, house interior trim
Carpet strip, house interior trim
Carts, dump
Carvings, wood
Cases, clock
Cases, sample
Cases, silverware
Cases, type
Casing, door
Casing, house
Casing, window
Ceiling
Chair rail, house interior trim
Cheeks, piano case
China closet, interior
Clog soles (shoe)
Clothes driers
Coal boxes, traction engine
Colonnades, house interior trim
Communion rails, church
Consoles
Corner blocks, house interior trim
Crates
Crating
Cups, soap
Curtain stretchers
Display forms, hosiery
Display forms, shoe
Doll parts
Doors
Doors, folding
Doors, sliding
Dowels
Dust cap, house interior trim
Dust conveyors, threshing machine
Dust guards, freight car axles
Dust guards, railway cars
Elevators, flour mill
Excelsior
Excelsior, packing
Excelsior, ribbon (mattress stuffing)
Fall boards, piano cases
Feet, piano
Fillet, house interior trim
Flag sticks (railway)
Flat battens, house interior trim
Flooring
Frames, corn graders
Frames, front door side light
Frames, jewelry case
Frames, lounge
Frames, mirror
Frames, picture
Frames, store fixture
Frames, suit case
Front doors, house
Game boards
Grain registers, threshers
Grilles, house interior trim
Handles, broom
Handles, brush
Handles, long handled dust brush
Handles, mop
Handles, pipe
Handles, plastering trowel
Handles, street brushes
Handles, wall brush
Handles, window brush
Head blocks, house interior trim
Head casing, house interior trim
Heading, nail keg
Heading, slack cooperage
Interior finish, churches
Interior frames, store fixtures
Ironing boards, folding
Jambs, door
Key blocks, piano cases
Key bottoms, piano cases
Key slips, piano cases
Ladders, step
Lath
Lids, grape basket
Mantels
Mantels, painted work
Meeting rail, sash
Mirror doors, house
Molding, bed, house construction
Molding, brick, house construction
Molding, cap, house interior trim
Molding, casket
Molding, cove
Molding, crown, house interior trim
Molding, drip cap, house construction
Molding, electric wire
Molding, piano cases
Molding, picture
Molding, plaster, house construction
Molding, quarter round
Molding, spring cove, house construction.
Molds, butter
Mud shields, traction engine
Mullions, sash
Music shelf, piano cases
Nosing, house interior trim
Novelties
Novelties, burnt wood
Pails, candy
Panel strips, house interior trim
Panels, door
Paper pulp
Parting strip, house interior trim
Partition moulds, house interior trim
Pedal boards, piano cases
Pews, church
Pianos, toy
Pilasters, piano cases
Pipes, organ
Plate rail, dining room
Racks, curtain display
Racks, rug display
Rails, door
Rails, table
Reels, electric wire
Reels, solder wire
Refrigerators
Rims, split wood pulleys
Sash, window
Seats, automobile
Seats, chair
Seats, tricycle
Serving tables, hidden work
Shelving
Sideboards, interior work
Side boards, wheelbarrow
Sides, piano cases
Sides, toy wagons
Sides, wagon bodies
Sides, wheelbarrow
Siding, house
Sink aprons, house interior trim
Slats, automobile tops
Slats, wagon tops
Spouting, flour mill
Stands, bible
Staves, slack cooperage
Staves, tight cooperage
Step ladders
Sticks, umbrella
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
Stretchers, curtain
Strips, felt bound school slates
Tables
Tables, ironing
Templates, shipbuilding
Top panels, piano cases
Top rails, sash
Top slats, light delivery wagon bodies
Tops, kitchen table
Tops, piano cases
Tops, table
Toy pianos
Trays, incubator
Trays, trunk
Trunks
Veneer
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Wheelbarrows, toy
Window apron, house interior trim
Window stool, house interior trim

BEECH.

Acetate of lime
Alcohol, wood
Astragals, folding door
Astragals, sliding door
Back posts, piano
Backing, desk
Backs, chair
Backs, drawer
Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Baskets
Baskets, split
Bay brackets, house construction
Beams, dining room ceiling
Blocks, brake
Blocks, brush
Boards, bosom
Boards, bread
Boards, lap
Boards, pastry
Book shelves
Bottom panels, piano cases
Bottom rail, porch
Bottom rails, sash
Bottoms, basket
Bottoms, carriage bodies
Bottoms, fruit baskets
Bottoms, jack plane
Bottoms, wagon bodies
Boxes, comb
Boxes, foundry moulding
Boxes, knife
Boxes, packing
Boxes, plate glass packing
Boxes, salt
Boxes, tin plate
Brackets, mine
Brackets, plate rail
Brackets, porch
Brooms, street
Capping, sink, house interior trim

BEECH—Continued.

Carpet strip, house interior trim
Cases, blacking
Cases, shipping
Casing, door
Casing, window
Celery crates
Center arms, split wood pulleys
Chair rail, house interior trim
Chairs, childrens'
Chairs, folding camp
Chairs, ladder
Charcoal
Cheeks, piano case
Chips, brewers
Chopping bowls
Clamps, trouser hanger
Clothes driers
Colonnades, house interior trim
Commodes
Consoles
Corner blocks, house interior trim
Costumers
Cots, camp
Crating
Cresting, porch roof
Cross-ties, railroad
Door boards, coal car
Door boards, railway grain car
Doors, folding
Doors, sliding
Dowels
Dust cap, house interior trim
End sills, log cars
Face brackets, house construction
Fall boards, piano cases
Feet, piano
Felloes, wheelbarrow wheel
Fillet, house interior trim
Fixtures, curtain
Flat battens, house interior trim
Flooring, house
Flooring, mine dump cars
Frame work, farm machinery
Frames, buck saw
Frames, corn sheller
Frames, door
Frames, front door side light
Frames, light vehicles
Frames, school slate
Frames, window
Frieze rail, porch
Front doors, house
Furniture, camp
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Handles, awl
Handles, boning knife
Handles, broom
Handles, butcher knives
Handles, carpenter try-square
Handles, coal sieve
Handles, crosscut saw
Handles, fruit baskets
Handles, lawn rake
Handles, long handled dirt pans
Handles, plane
Handles, skinning knives
Handles, steak knife
Handles, sticking knife
Handles, wheelbarrow
Handles, whip
Hangers, clothes
Hangers, garment
Head blocks, house interior trim
Head casing, house interior trim
Heading, cooperage
Heading, nail keg
Heading, slack cooperage
Hubs, wheelbarrow
Interior finish, freight cars
Jambs, door
Key blocks, piano case
Key bottoms, piano cases
Key slips, piano cases
Lath
Legs, table
Legs, ironing board
Mantels
Medicine cabinets
Mine props
Meeting rails, sash
Mirror doors, house
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, piano case
Moulding, plaster, house construction
Moulding, quarter round
Moulding, spring cove, house construction
Mullions, sash
Music shelf, piano case
Nosing, house interior trim
Novelties
Panel strips, house interior trim
Panels, door
Paper pulp
Parasol sticks
Partition moulds, house interior trim
Parts, bookbinders machinery
Pedal boards, piano cases
Pilasters, piano cases
Pins, cartridge
Pins, clothes
Pipe, wooden water
Planes, moulding
Plate rail, dining room
Poles, curtain
Porch columns, built up
Porch newels, built up
Porch spandrels
Posts, chair
Posts, dresser
Rails, bed
Rails, door
Rails, kitchen table
Reels, hose
Refrigerators, exterior
Rims, fruit baskets
Rounds, chair
Ruling machines, bookbinders
Rungs, ladder
Screens, door
Screens, window
Scroll sawed balusters, porch
Seats, buggy
Seats, lawn swings
Sides, cheese box
Sides, drawer
Sides, mine dump cars
Sides, piano case
Sides, step ladder
Sink aprons, house interior trim
Slats, ash can
Slats, lawn swings
Slides, table
Spindles, porch
Sprags, mine
Staffs, flag
Staves, cement barrel
Staves, cooperage
Staves, slack cooperage
Step ladder chairs
Steps, step ladder
Sticks, flower
Sticks, umbrella
Stiles, door
Stools, camp
Stops, door, house interior trim
Stops, window, house interior trim
Tabourettes
Tongues, toy wagon
Top panels, piano case
Top rail, porch
Top rails, sash
Tops, kitchen table
Tops, piano cases
Tops, sleds
Toy express wagons
Toy furniture
Toy tops
Traps, game
Traps, mouse
Traps, rat
Veneer
Wainscot, rail, house interior trim
Wainscoting cap, house interior trim
Walkers, baby
Wedges, mine cap
Wheelbarrows
Window apron, house interior trim
Window stool, house interior trim
Wire cloth display racks

BIRCH, BLACK.

Benches, piano
Cabinets, medicine
Costumers
End sills, log car
Felloes, heavy vehicle wheels
Handles, butcher knives
Rims, automobile wheels
Studding, log cars

BIRCH, PAPER.

Backing, cabinet
Backs, brush
Baskets
Blocks, brush
Bobbins
Boxes, druggists'
Chair frames, rattan
Chairs, turned parts
Clothespins
Excelsior
Handles, brush
Handles, carrying
Handles, edge tools
Handles, engravers tools
Handles, file
Handles, pail
Hubs, toy wagon
Hubs, toy wheelbarrow
Knobs
Knobs, drawer
Molding, piano
Novelties
Organ parts
Plugs, paper
Poles, rug
Rollers, curtain
Rollers, lawn mower
Shelving, cabinet
Spindles, chair
Spools
Spools, ribbon
Spoons, wooden
Sticks, candy
Toothpicks
Toys
Turnings
Wheels, toy wagon
Wood wool

BIRCH, SWEET.

Acetate of lime
Alcohol, wood
Arms, chair
Astragals, folding door
Astragals, sliding door
Axles, farm wagon
Backs, chair
Back posts, chair
Back posts, piano
Backing, postoffice furniture
Backing, desk
Balusters, stair
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Baskets
Baskets, fruit and vegetable
Baskets, split
Beams, dining room ceiling
Beds, folding
Benches, piano
Blocks, brake
Blocks, brush
Boards, meat
Boards, potato chip
Boards, slaw
Boat parts, row
Bodies, light vehicle
Bookcases, exterior
Bookcases, interior
Bookracks
Bottom panels, piano cases
Bottoms, automobile seat
Bottoms, carriage bodies
Bottoms, heavy vehicle bodies
Bottoms, wagon
Bottoms, wagon body
Box shooks
Boxes
Boxes, cheese
Boxes, comb
Boxes, glove
Boxes, knife
Boxes, packing
Boxes, plate glass packing
Boxes, salt
Boxes, telephone
Boxes, veneer
Boxes, veneered
Bowls, chopping
Brackets
Brackets, mine
Brackets, plate rail
Brackets, stair
Brackets, wall (stair)
Bread boards
Buffets, bar room
Bureaus, exterior
Cabinet work
Cabinet work, passenger cars
Cabinets
Cabinets, medicine
Cabinets, music
Cabinets, parlor
Cabinets, phonograph
Cabinets, toilet
Cabins, interior, yachts
Cabins, interior, ships
Cabins, interior, river craft
Capitals
Carpet strip, house interior trim
Cars, elevator
Cases, blacking
Cases, clock
Cases, medicine
Cases, organ
Cases, piano
Cases, railroad tickets
Cases, shipping
Cases, wall
Cases, water closet tanks
Casing
Casing, door
Casing, window
Caskets
Chair rail, house interior trim
Chairs
Chairs, adjustable
Chairs, barber
Chairs, dining room
Chairs, office
Charcoal
Cheeks, piano case
China closets
Clamps, trouser hanger
Coffins
Colonnades, house interior trim
Columns, porch
Commodes
Consoles
Cores, veneer
Corner blocks, house interior trim
Cornice, house construction
Costumers
Couches
Counter tops, bar room
Counters, bar
Counters, office
Counters, store
Cradles
Crating
Cutting boards, meat
Davenports
Decking, canoe
Division boards, collapsible crates
Doors
Doors, folding
Doors, sliding
Dowels
Dowels, parasol
Drawers, post-office furniture
Dressers,
Dressing tables, exterior
Dust cap, house interior trim
Exterior finish, house
Fall boards, piano cases
Feet, piano
Fillet, house interior trim
Fixtures, bar room
Fixtures, barber shop
Fixtures, curtain
Fixtures, laboratory
Fixtures, office
Fixtures, soda fountain
Fixtures, store
Flat battens, house interior trim
Flooring
Flooring, house
Flooring, inlaid
Flooring, mine dump cars
Frame work, farm machinery
Frames, chair
Frames, cheval mirror
Frames, davenport
Frames, door
Frames, front door side lights
Frames, light vehicle bodies
Frames, light vehicle seat
Frames, lounge
Frames, parlor furniture
Frames, roller towel
Frames, sofa
Frames, upholstered furniture
Furniture, case goods
Game boards
Gear parts, light vehicles
Grille work
Grilles
Grilles, house interior trim
Hall racks
Handles, coal sieve
Handles, file
Handles, hoe
Handles, lawn rake
Handles, rake
Handles, saw
Handles, screw wrenches
Handrails, porch
Handrails, stair
Head blocks, house interior trim
Head casing, house interior trim
Heading, cement barrels
Heading, cooperage
Heading, slack cooperage
Interior finish
Interior finish, freight cars
Interior finish, house
Jambs, door
Key blocks, piano cases
Key bottoms, piano cases
Key slips, piano case
Keys, organ
Keys, piano
Ladders, exterior
Ladders, step
Lath
Launch parts
Leaves, table
Leg, table
Lining, motor boats
Lounges
Mantels
Medicine cabinets
Mirror doors, house
Moulding, bed, house construction
Moulding cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Mouldings, piano
Mouldings, piano case
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, spring cove, house construction
Moulds, butter
Mullions, sash
Music cabinets
Music shelf, piano cases
Newel posts, angle
Newel posts, starting
Nosing, house interior trim
Novelties
Organ cases, exterior pipe
Ornaments, furniture
Panel strips, house interior trim
Panel work, show windows
Panels
Panels, stair work
Panels, veneered
Paper pulp
Parquetry flooring
Partitions, office
Patitions, post office letter racks
Partitions, store
Parts, row boat
Passenger cars, interior finish
Patterns, machine
Pedal boards, piano cases
Pedestals
Pen racks
Pilasters
Pilasters, piano cases
Pillars, chair
Pins, cartridge
Pins, clothes
Pipe, wooden water
Pipes, (imitation calabash)
Plate rail, dining room
Poles, curtain
Racks, book
Racks, display
Racks, key
Rails, stair
Reels, fence wire
Refrigerators
Rims, split wood pulleys
Risers, stair
Rockers, chair
Rollers, towel
Rosettes, wall (stairway)
Rough horses, stair
Rounds, chair
Ruling machines, bookbinders
Rungs, chair
Sash
Seat frames, canoe
Screens, door
Screens, window
Seats, chair
Seats, water closet
Sewing machine parts
Shelves, book
Shoe rails, stair
Showcase
Sideboards, exterior
Sides, bookcase
Sides, cheese boxes
Sides, china closet
Sides, desks
Sides, dressers

BIRCH, SWEET—Continued.

Sides, mine dump cars
Sides, piano cases
Sills, cart
Sink mats
Slats, bed
Slides, table
Somnols
Spindles, chair
Spools, electric wire
Sprags, mine
Staffs, flag
Staves, cement barrels
Staves, cooperage
Staves, slack cooperage
Sticks, flower
Stools, foot
Stools, office
Stools, piano
Stops, door, house interior trim
Store fronts
Stretchers, chair
String boards, stair
Swings, lawn
Switchboards, telephone
Tables
Tables, billiard
Tables, library
Tables, pool
Tables, sewing
Tabourettes
Tool chests
Top panels, piano cases
Top slats, light delivery wagon bodies
Tops, case goods
Tops, piano cases
Tops, post office furniture
Tops, table
Toy chairs
Toy furniture
Toy tops
Trays, pen
Treads, stair
Veneer
Veneer cores, piano cases
Wagon boxes
Wagons
Wainscoting
Wainscoting cap, house interior trim
Wainscot rail, house interior trim
Wardrobes
Wardrobes, exterior
Wedges, mine cap
Window apron, house interior trim
Window stool, house interior trim

BIRCH, YELLOW

Balls, croquet
Blinds
Blocks, brush
Boards, chopping
Bobbins
Boxes, butter
Boxes, packing
Boxes, tinware
Cabinets, kitchen
Chair arms, railway cars
Chairs, folding
Chairs, kitchen
Controller box casing, electric cars
Costumers
Covers, switch boxes, electric cars
Crates, tinware
Crating
Cupboard doors, railway cars
Dairy accessories
Dishes, butter
Facing, window partition
Handles, broom
Handles, dust brush
Handles, wrench
Heads, spool
Horses, clothes
Implements, agricultural
Interior finish, electric cars
Interior finish, railway cars
Interior finish, railway coaches
Mallets, croquet
Middles, spool
Mills, coffee
Mirrors, hand
Moulds, butter
Novelties
Panel wainscoting, railway cars
Panels, ceiling, railway cars
Panels, window, railway cars
Pins, clothes
Plates, pie
Prints, butter
Sash, electric cars
Sash, railway cars
Screens, door
Screens, window
Seats, chair
Sills, inside window (electric cars)
Sills, window, inside (railway cars)
Sleds
Spools
Tables, kitchen
Tenpins, toy
Toy furniture
Toy tops
Toys
Turnings

BOXWOOD

Boxes, comb
Engravings, wood
Handles, umbrella
Handles, shaving brush
Quoins, printers'
Rules, carpenters'
Scales, draftmen's
Shuttles
Type measures, printers'

BRIAR ROOT

Pipes, smoking

BUCKEYE, OHIO

Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Bay brackets, house construction
Beams, dining room ceiling
Blind stop, house construction
Boards, ironing
Boards, pastry
Boards, sleeve
Bottom rail, porch
Boxes, packing
Brackets, plate rail
Brackets, porch
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, door
Casing, window
Chair rail, house interior trim
Colonnades, house interior trim
Corner blocks, house interior trim
Cresting, porch roof
Doors, folding
Doors, sliding
Dust cap, house interior trim
Face brackets, house construction
Fillet, house interior trim
Flat battens, house interior trim
Frames, door
Frames, front door side lights
Frames, window
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Head blocks, house interior trim
Head casing, house interior trim
Jambs, door
Mantels
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screw
Moulding, sprung cove, house construction
Nosing, house interior trim
Panel strips, house interior trim
Parting stop, house interior trim
Partition moulds, house interior trim
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Racks, clothes
Racks, towel
Scroll sawed balusters, porch
Siding, house
Sink aprons, house interior trim
Slide, fly screen
Spindles, porch
Stops, door, house interior trim
Stops, window, house interior trim
Top rail, porch
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

BUTTERNUT

- Base blocks, house interior trim
- Baseboard, house interior trim
- Base corners, house interior trim
- Base moulding, house interior trim
- Beams, dining room ceiling
- Brackets, plate rail
- Capping sink, house interior trim
- Carpet strip, house interior trim
- Casing, door
- Chair rail, house interior trim
- Chests, clothes
- Chests, flour
- Colonnades, house interior trim
- Corner blocks, house interior trim
- Doors, folding
- Doors, sliding
- Drain boards, sink
- Dust cap, house interior trim
- Excelsior, packing
- Excelsior ribbon (mattress stuffing)
- Fillet, house interior trim
- Finish, boats
- Flat battens, house interior trim
- Frames, door
- Front doors, house
- Grilles, house interior trim
- Head blocks, house interior trim
- Head casing, house interior trim
- Interior finish
- Jambs, door
- Mantels
- Moulding
- Moulding, bed, house interior trim
- Moulding, cap, house interior trim
- Moulding, cove
- Moulding, crown, house construction
- Mirror doors, house
- Moulding, drip cap, house construction
- Moulding, picture
- Moulding, quarter round
- Moulding, spring cove, house construction
- Nosing, house interior trim
- Panel strips, house interior trim
- Paper pulp
- Patterns, foundry
- Plate rail, dining room
- Rims, split wood pulleys
- Ship furniture
- Sink aprons, house interior trim
- Wainscoting cap, house interior trim
- Wainscot rail, house interior trim
- Window apron, house interior trim
- Window stool, house interior trim

CEDAR, RED

- Benches, porch
- Benches, rustic lawn
- Box shooks
- Boxes, fuel
- Butter workers, dairymen's
- Cabinets, parlor
- Cases, casket
- Cases, coffins
- Caskets
- Ceiling
- Chests, clothes
- Churns, butter
- Coffins
- Cross arms, telegraph pole
- Cross ties, railroad
- Faucets, oil barrel
- Frames, couch
- Frames, davenport
- Frames, lounges
- Frames, upholstered furniture
- Handles, paint brushes
- Handles, varnish brushes
- Lining, closets
- Lining, clothes closets
- Pencils
- Pergolas
- Posts, fence
- Shingles
- Siding, house
- Silos
- Summer houses
- Tanks
- Vats

CEDAR, SPANISH

- Cigar boxes
- Decking, motor boat
- Floor boards, rowboat (round bottom)
- Handles, tennis racket
- Hulls, boats
- Hulls, canoes
- Hulls, racing shells
- Planking, canoe
- Planking, rowboats (flat bottom)
- Ribs, canoe
- Veneer

CEDAR, WESTERN RED

- Cabinet work
- Caskets
- Ceiling
- Cornice work
- Fixtures, office
- Flooring, porch
- Frames, screen door
- Frames, window screen
- Shingles
- Siding
- Silos
- Tanks, windmill

CEDAR, WHITE

- Boat boards
- Boat siding
- Boats, motor
- Boats, superstructure
- Box shooks
- Canoes
- Decking, motor boat
- Finish, interior
- Furniture
- Hulls, boat
- Hulls, canoes
- Hulls, racing shells
- Pickets, wire fence
- Planking, canoe
- Planking, boat
- Planking, motor boat
- Planking, yacht
- Ribs, canoe
- Siding, canoe
- Siding, launch
- Silos
- Tanks
- Tanks, paper mill
- Tubs, washing machine
- Vats

CEIBA

- Shuttles

CHERRY

- Acetate of lime
- Actions (organs)
- Alcohol, wood
- Backing, electrotype
- Backs, clothes brush
- Backs, drawer
- Backs, hairbrush
- Backs, nail brush
- Balusters (stair)
- Balusters, stairway
- Base blocks, house interior trim
- Baseboards
- Baseboard, house interior trim
- Base corners, house interior trim
- Base moulding, house interior trim
- Beams, dining room ceiling
- Blinds, venetian
- Blocks, brush
- Booths, telephone
- Boxes, plate glass packing
- Boxes, roller sign (electric cars)
- Boxes, sewing
- Boxes, veneer
- Brackets, plate rail
- Brackets, stair
- Brackets, stairway
- Brushes
- Bureaus, exterior
- Cabinet work
- Cabinet work, boat
- Cabinet work (electric cars)
- Cabinet work (Pullman cars)
- Carpet strip, house interior trim
- Carvings, wood
- Cases, dental
- Cases, optical
- Cases, wall
- Cases, water closet tank
- Casing, door
- Casing, window
- Casings
- Caskets
- Chair arms, Pullman coaches
- Chair rail, house interior trim
- Charcoal
- Chiffoniers
- Coffins
- Colonnades, house interior trim
- Colonnades, Pullman coaches

CHERRY—Continued

Commodes
Consoles
Corner blocks, house interior trim
Counters, bar
Counters, store
Covers, switch boxes (electric cars)
Covers, switch box (Pullman coaches)
Cupboard doors, Pullman coaches
Dashboards, automobile
Deck trimmings, motor boat
Doors
Doors, folding
Doors, sliding
Doors, upper berth, sleeping cars
Drawer parts, office fixtures
Drawer parts, store fixtures
Dust cap, house interior trim
Facing, window partition (electric cars)
Files, newspaper
Fillet, house interior trim
Finish, interior (automobile bodies)
Fixtures, bank
Fixtures, bar
Fixtures, barber shop
Fixtures, office
Fixtures, store
Fixtures (store display)
Fixtures, window display
Flat battens, house interior trim
Flooring
Flooring, parquetry
Foot rails (stair)
Foot rail, stairway
Frames, door
Frames, mirror
Frames, picture
Furniture, bank
Furniture (barroom)
Furniture, barber shop
Furniture, drug store
Furniture (office)
Furniture, store
Grilles
Grilles, house interior trim
Grilles, Pullman coaches
Hand rail, stairway
Handles, reciprocating drills
Handles, varnish brushes
Head blocks, house interior trim
Head casing, house interior trim
Heading, nail keg
Interior finish
Interior finish (camera)
Interior finish, electric cars
Interior finish, Pullman coaches
Interior trim, house
Jambs, door
Levels, carpenters'
Lids, water closet
Linings, boat
Lunch tables, portable (Pullman coaches)
Mantels
Mantels, soda fountain
Mirror doors, house
Mirror frames, passenger elevator cars
Mirror frames, Pullman coaches
Models
Models, machine
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding crown, house construction
Moulding, drip cap, house construction
Moulding, plaster, house construction
Moulding, quarter round
Moulding, spring cove, house construction
Moulds, fire brick
Mountings, electrotype
Newel posts, angle
Newel Posts, starting
Nosing, house interior trim
Organs, cabinet
Organs, pipe
Panel strips, house interior trim
Panel wainscoting, Pullman coaches
Panel work, office partitions
Panel work, store fixtures
Panels, ceilings (Pullman coaches)
Panels, door
Panels, passenger elevator cars
Panels, window (Pullman coaches)
Paper pulp
Partitions, office
Partitions, store
Parts, automobile bodies
Patterns
Patterns, foundry
Peel blades, bakers'
Pipes, organ
Plate holders (camera)
Plate rail, dining room
Platforms, counter scales
Poison cases (drug store)
Press boards, bookbinders'
Push button frames (Pullman coaches)
Rails, door
Rails, stair
Rails, table
Range finders, camera
Refrigerators, soda fountain
Risers, stairway
Ruling machines, bookbinders'
Sash
Sash, automobile
Sash, electric cars
Sash, Pullman coaches
Seats, water closet
Seats, wire frame chairs
Show cases
Sides, drawer
Sills, inside window (electric cars)
Slides, drawer
Squares, draftsman
Stands, city directory
Stiles, door
Stops, door, house interior trim
Tops, counter
Tops, table
Tops, wire frame tables
Track sections, camera
Treads, stair
Triangles (billiard)
Triangles, draftsman
Veneer
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

CHERRY, WILD

Paper pulp

CHESTNUT

Astragals, folding door
Astragals, sliding door
Backs, brush
Backing, bureau
Backing, desk
Backing, dresser
Backing, furniture
Backing, sideboards
Backing, washstand
Backs, piano
Balusters (stair)
Base blocks, house interior trim
Baseboards
Baseboard, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Beams, dining room ceiling
Beds, folding
Bedsteads, exterior
Bedsteads, hidden work
Blinds, window
Bodies, toy wheelbarrows
Bookcases, sectional
Book racks, revolving
Booths, voting (exterior)
Bottoms, grape basket
Box ends, fertilizer sowers
Box shooks
Boxes, clothiers'
Boxes, coal sieve
Boxes, packing
Boxes, plant
Boxes, tin plate
Boxes
Boxing
Brackets, plate rail
Brackets, stair
Buffets, exterior
Bureaus, hidden work
Bureaus, exterior
Bushel crates
Cabinets, magazine
Cabinets, scale
Cabinets, smokers,
Carpet strip, house interior trim
Cars, passenger elevator
Cases (casket)
Cases, medicine
Cases, piano
Cases, veneer
Casing
Casing, door
Casing, window
Caskets
Ceiling
Cellarettes
Chair rail, house interior trim
Chairs
Chairs, arm
Chairs, desk
Chairs, mission
Chairs, rocking
Chests, hall
Chiffoniers
China cases, shelving
Coffins
Colonnades, house interior trim
Columns, china closet
Columns, sideboard
Commodes
Consoles
Cores, door
Cores, veneering
Corner blocks, house interior trim
Couch frames
Counters, store
Crates
Crating
Cross arms, telegraph pole
Cross ties, railroad
Desks
Doors
Doors, folding
Doors, sliding
Drain boards, sink
Drawer fronts
Drawer sides
Dressers

CHESTNUT—Continued

Dust cap, house interior trim
Fillet, house interior trim
Fixtures, bank
Fixtures, bar
Fixtures, barber shop
Flasks, foundry
Flat battens, house interior trim
Flooring
Flooring, porch
Foot rests
Footstools
Frames, coal sieves
Frames, furniture
Frames, lounge
Frames, mirror
Frames, office fixtures
Frames, picture
Frames, upholstered chairs
Frames, upholstered furniture
Front doors, house
Furniture
Furniture, bed room
Furniture, mission
Furniture, office
Grilles, house interior trim
Hall mirror hatracks
Head blocks, house interior trim
Head casing, house interior trim
Heading, slack cooperage
Interior frames, office fixtures
Interior finish, house
Jambs, door
Keyboards, organ
Keyboards, piano
Kitchen furniture
Lath
Lids, grape basket
Mantels
Mirror doors, house
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, picture
Moulding, plaster, house interior trim
Moulding, quarter round
Moulding, spring cove, house construction
Moulding, stair
Newel posts, angle
Newel posts, starting
Nosing, house interior trim
Outer cases
Panel cases, veneer doors
Panel strips, house interior trim
Panels, organ case
Panels (piano cases)
Panels, veneer
Partitions
Partition moulds, house interior trim
Parts, flour mill machinery
Pickets, fence
Plate rail, dining room
Posts, porch
Rails, billiard tables
Rails, china closet
Rails, shoe (stair)
Rails, stair
Refrigerators
Refrigerators, exterior
Risers, stair
Roller feeders, flour mill machinery
Rosettes, wall (stairway)
Screens, fire
Seats, chair
Settees
Settles
Sewing machine parts
Sheathing
Sheathing, house
Shelves, book
Shelves, piano
Shingles
Showcase
Sideboards
Sideboards, built in
Sideboards, exterior
Sides, billiard tables
Siding, house
Sides, piano cases
Siding, plate glass shipping cases
Slats, trunk
Sofas, exterior
Stands, plant
Staves, cement barrels
Staves, slack cooperage
Staves, tight cooperage
Stops, door, house interior trim
String boards (stair)
Swell boxes, pipe organ
Tables, dropleaf
Tables, extension
Tables, library
Tables, tea
Tool chests, toy
Top frames, piano
Tops, piano
Tops, table
Toy furniture
Toy tops
Treads, stair
Veneer
Veneer cores, piano cases
Wainscot rail, house interior trim
Wainscoting
Wainscoting cap, house interior trim
Washstands
Washstands, exterior
Window apron, house interior trim
Window stool, house interior trim

COCOBOLO

Handles, butcher steel
Handles, carpenters' brace
Handles, combination tool sets
Handles, hand wood drill
Handles, palette knife
Handles, paring knives
Handles, putty knife
Handles, scraping knife
Heads, carpenter brace

CONGO

Handles, umbrella

COTTONWOOD

Balusters, porch
Base blocks, house interior trim
Baseboard, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Baskets, berry
Battens, O. G. barn
Bay brackets, house construction
Beams, dining room ceiling
Beds, manure spreaders
Bevel siding, house
Bins, curd grinding machines
Blind stop, house construction
Boards, ironing
Boards, skirt
Boards, mortar
Boards, pastry
Bottom rail, porch
Bottom rails, sash
Bottoms, drawer
Bottoms, trunk
Bottoms, trunk trays
Boxes, bottle
Boxes, bottlers
Boxes, packing
Boxes, trunk
Boxes, wheat drills
Brackets, plate rail
Brackets, porch
Brooders, poultry
Cabinets, inside work
Cabinets, kitchen
Capping, sink, house interior trim
Carpet strip, house interior trim
Cases, beer
Cases, egg
Casing, door
Casing, window
Caskets
Chair rail, house interior trim
Cigar boxes
Cloth boards
Coffins
Colonnades, house interior trim
Commodes, interior
Consoles
Cooperage, slack
Coops, poultry
Corner blocks, house interior trim
Crates, berry
Crates, milk bottle
Crating
Cresting, porch roof
Cupboards, kitchen
Doors, folding
Doors, sliding
Dowels, chair
Drawers, incubator
Excelsior
Face brackets, house construction
Fillet, house interior trim
Fixtures, barroom
Fixtures, office
Fixtures, store
Flat battens, house interior trim
Footstools
Frames, box couches
Frames, door
Frames, front door sidelight
Frames, upholstered furniture
Frames, wood
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Head blocks, house interior trim
Head casing, house interior trim
Hoppers, curd grinding machines
Incubators
Interior work, electric shoe shining machines
Jambs, door
Lath
Lining, freight cars

COTTONWOOD—Continued

Lining, wagon bodies
Mantels
Meeting rails, sash
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Mullions, sash
Nosing, house interior trim
Packages, fruit
Packing cases, plate glass
Panels, agricultural machinery
Panels, door
Panels, light vehicle bodies
Panels, light vehicle seats
Panels, spring wagon bodies
Panel strips, house interior trim
Panels, threshing machine
Parting stop, house interior trim
Partition molds, house interior trim
Parts, door
Parts, flour mill machinery
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Roof slats, wagon bodies
Scroll sawed balusters, porch
Shredders, fodder
Shipping cases, butter
Sides, farm wagon bodies
Sink aprons, house interior trim
Slide, fly screen
Soil rollers
Spindles, porch
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
Tables, kitchen
Top rail, porch
Top rails, sash
Tops, kitchen cabinets
Tops, kitchen table
Tops, trunk
Tops, veneered, trunks
Tray bottoms (trunk)
Wainscoting cap, house interior trim
Wainscot rail, house interior trim
Washboards, laundry
Window apron, house interior trim
Window stool, house interior trim
Wood pulleys

CUCUMBER

Base blocks, house interior trim
Baseboard, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Beds, spring wagon
Blind stop, house construction
Brackets, plate rail
Carpet strip, house interior trim
Casing, door
Casing, house
Casing, window
Chair rail, house interior trim
Colonnades, house interior trim
Corner blocks, house interior trim
Doors, folding
Doors, sliding
Dust cap, house interior trim
Fillet, house interior trim
Frames, door
Frames, window
Grilles, house interior trim
Head blocks, house interior trim
Jambs, door
Mantels
Mantels, painted work
Mirror doors, house
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, quarter round
Moulding, spring cove, house construction
Nosing, house interior trim
Paper, pulp
Partition moulds, house interior trim
Plate rail, dining room
Rims, split wood pulleys
Siding, house
Slide, fly screen
Wainscoting cap, house interior trim
Wainscot rail, house interior trim
Window apron, house interior trim
Window stool, house interior trim

CYPRESS

Astragals, folding door
Astragals, sliding door
Balusters, porch
Bars, greenhouse
Base blocks, house interior trim
Baseboard, house interior trim
Baseboards
Base corners, house interior trim
Base moulding, house interior trim
Battens, O. G. barn
Bay brackets, house construction
Beams, dining room ceiling
Beams, pergola
Beehives
Belt poles, machinists'
Bevel siding, house
Blind stop, house construction
Blinds (house)
Bottom boards, rowboat
Bottom rail, porch
Bottom rails (sash)
Boxes, bottle
Boxes, packing
Brackets, plate rail
Brackets, porch
Brooders, interior
Cabins, exterior, river craft
Cabins, exterior, ships
Cabins, exterior, yachts
Cabins, interior, river craft
Cabins, interior, ships
Cabins, interior, yachts
Carpet strip, house interior trim
Cases, casket
Cases, coffin
Cases, incubator
Cases, packing
Casing
Casing, door
Casing, window
Caskets
Chair rail, house interior trim
Churns, butter
Coffins
Colonnades, house interior trim
Columns, pergola
Consoles
Corner beads, house interior trim
Corner blocks, house interior trim
Cornice, house construction
Cornice work, house
Crates, shipping
Cresting, porch roof
Cross arms, telegraph pole
Cross ties, railroad
Decking, motor boat
Doors,
Doors, folding
Door, railroad passenger coaches
Doors, sliding
Dust cap, house interior trim
Exterior finish, house
Face brackets, house construction
Fillet, house interior trim
Finish, locomotive cabs
Finish, yacht cabin
Flat battens, house interior trim
Floor boards, rowboat, round bottom
Flooring, porch
Frames, door
Frames, front door sidelights
Frames, window
Frieze rail, porch
Front door, house
Gable brackets, house construction
Gable ornaments, house construction
Gates, railroad crossing
Grilles, house interior trim
Hatch covers, river craft
Hatch covers, ship
Hatch covers, yacht
Head blocks, house interior trim
Head casing, house interior trim
Interior, cupboard
Interior finish, house
Jambs, door
Keels, canal boats
Keels, river craft
Keels, ship
Keels, yacht
Keels on rowboat (flat bottom)
Ladders
Lattice
Leeboards, canoe
Lids, washing machine
Mantels
Meeting rails (sash)
Mirror doors, house
Moulding, bed, house interior trim
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove

CYPRESS—Continued.

Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, exterior house
Moulding, picture
Moulding, plaster, house construction
Moulding, porch
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Moulding, stair
Mullions (sash)
Nosing, house construction
Panels, door
Panel strips, house interior trim
Parting strip, house interior trim
Partition moulds, house interior trim
Parts, automobile bodies
Planking, motor boat
Planking, river craft
Planking, ship
Planking, yacht
Plate rail, dining room
Porch colums, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch, spandrel
Rafters, pergola
Rails, door
Rudders, river craft
Rudders, ship
Rudders, yacht
Sash
Sash, hotbed
Sash, railroad passenger coach
Screens, door
Screens, window
Scroll sawed balusters, porch
Shingles
Sides, rowboat (flat bottom)
Silos
Slide, fly screen
Spindles, porch
Staves, tight cooperage
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
Sub-frames, hotbed
Tanks,
Tanks, dairyman's
Tanks, paper mill
Tanks, pickling
Tanks, wooden
Thresholds, porch door
Top rail, porch
Top rails (sash)
Tubs, washing machine
Vats
Vats, dairyman's
Vats, paper mill
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Washboards, dairyman's
Water tubs, wooden bridge
Window apron, house interior trim
Window stool, house interior trim

DOGWOOD

Bobbins
Handles, brick trowel
Handles, kitchen knife
Handles, kitchen fork
Handles, small tools
Mallets, coppersmith
Mallets, tinner's
Shuttles

DONCELLA

Shuttles

EBONY

Backs, clothesbrush
Backs, hairbrush
Canes
Checkers
Chessmen
Handles, chafing dish
Handles, drawing instruments
Handles, pocket knife
Handles, tea strainer
Handles, umbrella
Pipes, smoking
Walking sticks

ELM, CORK

Baskets, vegetable
Battens, dumb-waiters
Beams, elevator cars
Beds, coal wagon
Bent seats, automobile
Blocks, hub
Boxes, packing
Boxes, weight (dumb-waiter)
Boxes, wheat drills
Cabinets, kitchen
Chair rockers
Chairs, stepladder
Churns, butter
Cleats, dumb-waiters
Crating
Doubletrees
Dumb-waiters
Eveners
Egg cases
Frames, sieve
Friction blocks, derrick
Gear parts, flour mill machinery
Grain boxes, corn planters
Guide posts, dumb-waiters
Guide rails, dumb-waiters
Handles, machine
Handles, plow
Hay rake parts
Heading, slack cooperage
Hoops, slack cooperage
Hoppers, grain
Hounds, light vehicle
Hubs
Hubs, carriage wheels
Hubs, light delivery wagons
Hubs, light vehicles
Ladders
Over-head beams, dumb-waiters
Parts, automobile bodies
Parts, hay baler
Pews, church
Platforms, elevator
Platforms, machine
Reaches, light vehicle
Rims (automobile wheels)
Rims, basket
Rims, butter tub
Rollers, cable
Runners, sleigh
Shelves, dumb-waiters
Singletrees
Skids, engine
Staves, cement barrels
Staves, slack cooperage
Swings, lawn
Traps, mouse
Traps, rat
Trees, saddle
Trucks, gasoline engine
Tubs, lard
Whiffletrees
Yokes, neck

ELM, WHITE

Backs, chair
Backs, kitchen cabinets
Baskets
Baskets, split
Baskets, vegetable
Blocks, brush
Boards, ironing
Boards, pastry
Bookcases, inside work
Bodies, automobile
Boxes, wheelbarrow
Boxes, trunk
Boxes, knife
Boxes, comb
Boxes, cheese
Boxes, candy
Box shooks
Brooders, poultry
Bureaus, interior work
Bushel crates
Bushel measures
Cabinets, medicine
Cabinets, printers'
Cabinets, seed
Cases, type
Chairs
Chairs, kitchen
Chairs, rocking
Chests, ice
China closets, inside work
Commodes, inside work
Crating
Doors, automobile
Eveners
Fixtures, bar
Fixtures, office
Fixtures, store
Flasks, foundry
Flooring
Frames, chair
Frames, couch
Frames, cultivators
Frames, davenport
Frames, lounge
Frames, sofa
Frames, upholstered furniture
Furniture, toy
Game boards
Handles, basket
Handles, canthook
Handles, cross-cut saw
Handles, peavy
Heading, slack cooperage
Hoops, slack cooperage
Hubs, wheelbarrow
Ladders, step
Lath
Locomotive cabs, interior
Paper pulp
Parts, washing machine

ELM, WHITE

Pastry sets
Pews, church
Pins, insulator
Pokes, horse
Refrigerators
Rims, cheese box
Rims, sieve
Rungs, ladder
Seat frames, chair
Showcases
Sieves, ash
Signboards
Slats, trunk
Sleds, bob
Slides, extensionable
Splint baskets, porch hammocks
Stands, bible
Staves, slack cooperage
Stops, drawer
Tables, communion
Telephone apparatus
Tops, sleds
Traps, mouse
Traps, rat
Tubs
Washboards, laundry
Veneer

EUCALYPTUS

Furniture, special work

FIR, BALSAM

Freezers, ice cream
Lath
Oars, boat
Pulp, paper
Silos

FIR, DOUGLAS

Astragals, folding door
Astragals, sliding door
Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, O. G. barn
Bay brackets, house construction
Beams, dining room ceiling
Bevel siding, house
Blind stop, house construction
Blinds, window
Booms, river craft
Booms, ship
Bottom boards, barge
Bottom boards, row boat
Bottom boards, scow
Bottom rail, porch
Bottoms, piano cases
Brackets, plate rail
Brackets, porch
Brackets, telegraph pole
Bumping posts, railroad
Cabins, exterior, river craft
Cabins, exterior, ships
Cabins, exterior, yacht
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, door
Casing, window
Ceiling
Chair rail, house interior trim
Colonnades, house interior trim
Corner blocks, house interior trim
Cornice, house construction
Covers, vats
Covers, water tank
Cresting, porch roof
Cross-arms, telegraph pole
Cross-ties, railroad
Decking, boats
Decking (ship and boat)
Derricks, hoisting
Derricks, oil well
Doors, folding
Doors, sliding
Drop siding, house
Dust cap, house interior trim
Face brackets, house construction
Feed mill machinery parts
Fillet, house interior trim
Fireless cookers, exterior
Flat battens, house interior trim
Flooring, electric passenger cars
Flooring, freight cars
Flooring, house
Flooring, porch
Flooring, railway passenger coaches
Flooring, scale platforms
Frames, door
Frames, freight car
Frames, front door side light
Frames, target
Frames, window
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Gates, railway crossing
Hay balers, parts
Hayloaders, parts
Hayrakes, parts
Head blocks, house interior trim
Head casing, house interior trim
Hods, mortar
Jambs, door
Joiners, deck (ship)
Keels, canal boats
Keelsons, river craft
Keelsons, ship
Keelsons, yacht
Ladders, extension
Ladders, step
Lath
Lattice
Masts, river craft
Masts (ship)
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, interior trim
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Nosing, house interior trim
Panel strips, house interior trim
Parting strip, house interior trim
Partition, house
Partition moulds, house interior trim
Planking, barge
Planking, canal boat
Planking, river craft
Planking, scow
Planking, ship
Planking, yacht
Plate rail, dining room
Plates, railway car frames
Poles, flag
Poles, pike
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrel
Pump rods, windmill
Push poles, locomotive
Refrigerators, exterior
Ridge poles, railway car frames
Scroll sawed balusters, porch
Sides, row boat
Siding, barge
Siding, canal boats
Siding, railway box cars
Siding, railway passenger coaches
Sills, freight cars
Sills, oil well drilling machinery
Sink aprons, house interior trim
Slides, fly screen
Spars, ship
Spindles, porch
Staves, silo
Staves, tight cooperage
Staves, water tanks
Stops, door, house interior trim
Store fronts
Tongues, farm machinery
Top rail, porch
Towers, oil well
Towers, water
Vats
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

FIR, OREGON

Push poles, locomotive

GUM, BLACK

Baskets, split
Blocks, hub
Boxes, tin ware
Crates, tin ware
Cross-ties, railroad
Fenders, river craft
Friction blocks (railway cars)
Heading, oil bands
Hubs
Hubs, carriage wheels
Hubs, light delivery wagon
Hubs, wheelbarrow

GUM, BLACK—Concluded

Mauls
Mine rollers
Packing cases, plate glass
Rollers, car
Rollers, mine
Staves, oil barrels

GUM, COTTON

Baskets, splint
Baskets, vegetable
Bottoms, drawer
Boxes, berry
Boxes, cigar
Boxes, cracker
Boxes, milk bottle
Boxes, packing
Boxes, trunk
Cases, sample
Cases, traveling
Coops, poultry
Crates, beer
Crates, fruit
Crates, vegetable
Crating
Cross-ties, railroad
Dishes, lard
Heads, maul
Hoppers, machine
Legs, table
Mallets, ship builders
Mortars
Paper pulp
Parts, agricultural machinery
Pestles
Pins, clothes
Plates, pie
Rammers, street
Rollers, awning
Rollers, shipbuilders
Truck barrels, veneered

GUM, BLACK

Baskets, split
Blocks, hub
Boxes, tin ware
Crates, tin ware
Cross-ties, railroad
Fenders, river craft
Friction blocks (railway cars)
Heading, oil barrels
Hubs
Hubs, carriage wheels
Hubs, light delivery wagon
Hubs, wheelbarrow
Mauls
Mine rollers
Packing cases, plate glass
Rollers, car
Rollers, mine
Staves, oil barrels

GUM, RED

Astragals, sliding door
Backs, chairs
Backing, case goods
Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Bay brackets, house construction
Beams, dining room ceiling
Blinds, house construction
Blocks, brake
Bottoms, case goods
Bottom rails, porch
Bottom rails, sash
Box shooks
Boxes, creamery shipping
Boxes, macaroni
Boxes, packing
Boxes, trunk
Brackets, porch
Cabinets, music
Capping, sink, house, interior trim
Carpet strip, house interior trim trim
Cases, casket
Cases, clock
Cases, coffin
Cases, sample
Cases, shipping
Casing, door
Casing, window
Caskets
Chair rail, house interior trim
Chairs, rocking
Coal boards, engine tender
Coffins
Colonnades, house interior trim
Consoles
Commodes
Coolers, water
Corner blocks, house interior trim
Crating
Cresting, porch roof
Cross-ties, railroad
Doors
Doors, folding
Doors, sliding
Drawer sides
Drawers
Drawers, cabinets
Dust cap, house interior trim
Face brackets, house construction
Fertilizer distributors, parts
Fillet, house interior trim
Flasks, foundry
Flat battens, house interior trim
Frames, chair
Frames, davenport
Frames, door
Frames, dresser
Frames, front door side light
Frames, window
Frieze rail, porch
Front doors, house
Front rails, beds
Front rails, dresser
Furniture
Gable brackets, house construction
Gable ornaments, house construction
Handles, saw
Handles, sadiron
Head blocks, pattern
Head blocks, house interior trim
Head cases, house interior trim
Hidden work, walnut furniture
House interior trim
Interior finish, house
Jambs, door
Jumpers, baby
Lath
Legs, chiffonier
Legs, dresser
Mantels
Meeting rails, sash
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Molding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, spring cove, house construction
Mullions, sash
Nosing, house interior trim
Panel strips, house interior trim
Panels, door
Panels, light delivery wagon bodies
Panels, light vehicle bodies
Panels, stair work
Paper pulp
Parting stop, house interior trim
Partition moulds, house construction
Pipes (smoking)
Plate rail, dining room
Plate rail, house interior trim
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Posts, beds
Posts, dresser
Pulleys
Rails, door
Rails, dresser
Refrigerators, exterior
Scroll-sawed balusters, porch
Seat frames, chair
Shelving, cabinets
Sink aprons, house interior trim
Slide, fly screen
Spindles, porch
Standards, chiffonier
Standards, dresser
Staves, cement barrels
Sticks, parasol
Stiles, door
Strips, weather
Stops, door, house interior trim
Stops, window, house interior trim
Tables, library
Top rail, porch
Top rails, sash
Tops, desk
Tops, dressers
Tops, chiffoniers
Tops, sideboards
Traps, mouse
Wainscoting cap, house interior trim
Wainscot rail, house interior trim
Walkers, baby
Window apron, house interior trim
Window stool, house interior trim

HEMLOCK

Astragals, folding door
Astragals, sliding door
Balusters, porch
Balusters (stair)
Barge construction
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, O. G. barn
Bay brackets, house construction

HEMLOCK—Concluded.

Beams, dining room ceiling
Blind stop, house construction
Booms, river craft
Booms, ship
Bottom boards, foundry flasks
Bottom rail, porch
Bottoms, river barge
Box shooks
Boxes, coal sieve
Boxes, packing
Brackets, plate rail
Brackets, porch
Brackets, stair
Bridge construction
Bull-wheel cants, oil well machinery
Cabins, canal boats
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, door
Casing, window
Chair rail, house interior trim
Cheese boxes, veneer
Colonnades, house interior trim
Consoles
Corner blocks, house interior trim
Cornice, house construction
Cornice work, house
Crating
Cresting, porch roof
Cross-ties, railroad
Decking, barge
Decking, canal boats
Doors, folding
Doors, sliding
Dust cap, house interior trim
Face brackets, house construction
Fencing
Fillet, house interior trim
Flasks
Flasks, foundry
Flat battens, house interior trim
Flooring
Flooring, freight elevator cars
Flooring, passenger elevator cars
Flooring, wharves
Frames, canal boat
Frames, coal sieve
Frames, door
Frames, freight car
Frames, front door side light
Frames, river craft
Frames, ship
Frames, window
Frames, yacht
Frieze rail, porch
Front doors, house
Fruit jar cases
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Hatch covers, river craft
Hatch covers, ship
Hatch covers, yacht
Head blocks, house interior trim
Head casing, house interior trim
Heading, nail keg
Heading, slack cooperage stock
Incubators
Jambs, door
Keels, river craft
Keels, ship
Keels, yacht
Kelsons, canal boat
Ladders, river craft
Ladders, ship
Lath
Lattice
Lining, canal boats
Mantels
Masts, river craft
Masts, ship
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Newel posts, angle
Newel posts, starting
Nosing, house interior trim
Packing, boat launching
Packing cases, plate glass
Pallets, fire brick
Panel strips, house interior trim
Paper pulp
Parting strip, house interior trim
Partition moulds, house interior trim
Patch-boards, freight car
Planking, canal boat
Planking, river craft
Planking, ship
Planking, yacht
Plate rail, dining room
Poles, flag
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrel
Rails (stair)
Reels, cable
Reels, wire rope
Refrigerators
Risers, stair
Rosettes, wall (stairway)
Rough horses (stairway)
Scroll-sawed balusters, porch
Seats, row boat
Shoe rails (stair)
Sides, ore car bodies
Sides, row boat
Siding, freight car
Siding, house
Siding, plate glass shipping cases
Sink aprons, house interior trim
Skidding (machine)
Skidding (steam-pump)
Slides, fly screen
Spars, ship
Spindles, porch
Stair horses
Stair work, hidden
Staves, silo
Staves, slack cooperage
Stems, canal boat
Stops, door, house interior trim
Stops, window, house interior trim
String boards(stair)
Thresholds, house interior trim
Top rail, porch
Transoms, row boat
Tread (stair)
Veneer
Wainscoat, rail, house interior trim
Wainscot cap, house interior trim
Weather boarding, house
Window apron, house interior trim
Window stool, house interior trim

HICKORY

Arms, chair
Axle beds, perch spring wagon
Axle beds, surrey
Axle beds, buggy
Axles, light vehicles
Axles, lumber wagons
Axles, wagon
Backs, rustic porch chairs
Backs, split chairs
Bottoms, wagon boxes
Boxes, creamery shipping
Bows, automobile top
Brake beams, freight car
Brake lining, hoisting engines
Canes, walking
Caps, axle
Caps, light vehicle
Carts, dump
Carts, road
Cogs, flour mill machinery
Cross bars, buggy shafts
Cross bars, light vehicle
Door boards, coal cars
Door boards, railroad grain cars
Doubletrees
Dowels
Eveners, buggy
Eveners, carriage
Eveners, wagon
Felloes
Felloes, heavy vehicle wheels
Felloes, light delivery wagons
Fifth wheel bars, light delivery wagon
Fifth wheel circles, light delivery wagon
Fifth wheel spools, light delivery wagon
Fillers, hame
Flooring, motor truck
Forks, shaking
Frames, bob sled
Frames, coal screen
Frames, gravel screen
Frames, porch chair, rustic
Frames, sand shaking screen
Gear parts, automobile
Gear parts, buggy
Gear parts, light vehicle
Gear parts, vehicle
Gear parts, wagon
Gear woods, flour mill machinery
Grain cradles
Hacks, vehicle
Hames
Handles, adze
Handles, axe
Handles, bench hatchet
Handles, blacksmith's hammer
Handles, bookbinders' machinery
Handles, broad hatchet
Handles, cant hook
Handles, chisel
Handles, double bitted axe
Handles, drawing knife
Handles, electric car
Handles, extension saw
Handles, golf club
Handles, go-devil
Handles, grab maul
Handles, granite hammer
Handles, grub hoe
Handles, hammer
Handles, hand drill
Handles, hatchet
Handles, single bitted axe
Handles, lawn rake
Handles, machinists' hammer
Handles, meat cleaver
Handles, masons' hammer
Handles, maul
Handles, paint brush
Handles, peavy
Handles, peeling axe
Handles, post mauls
Handles, rig builders' hatchet
Handles, riveting hammer
Handles, shingle and lathing hatchet
Handles, sledge hammer

HICKORY—Concluded

Handles, timber carver
Handles, trolley car
Heads, grab maul
Heads, mallet
Hind spring bars, light delivery wagon
Hounds, light delivery wagon
Interior finish, houses
Interior trim, house
Ladders, hay
Lower head blocks, light delivery wagon
Mallets
Mallets, printers'
Mauls
Neck yokes
Neck yokes, light vehicle
Neck yokes, wagon
Quoins, printers'
Parts, automobile body
Picker sticks, loom
Pole futchels, light delivery wagon
Poles, buggy
Poles, hanging strap (electric cars)
Poles, light vehicle
Posts, wagon body
Push poles, railway engine
Rails, automobile
Rammers
Rammers, concrete
Rammers, street
Reaches, buggy
Rests, foot, (electric cars)
Rests, foot, (railway cars)
Ribs, wagon top
Rims
Rims, automobile wheel
Rims, vehicle rims
Rims, wheel
Rollers
Rounds, chair
Rounds, split bottom chair
Rounds, ladder
Rungs, ladder
Runners, sleigh
Runner frames, sleigh
Runners, bob sled
Screws, bookbinder
Seats, rustic porch chair
Seats, split chair
Shackle bars, light delivery wagon
Shafts, buggy
Shafts, vehicle
Shooting sticks, printers'
Side futchels, light delivery wagon
Singletrees
Singletrees, light and heavy vehicles
Skewers, butchers'
Slackers
Splits, split bottom chair
Splint baskets, porch hammock
Splinter bars, light delivery wagon
Spokes, automobile wheel
Spokes, buggy wheel
Spokes, heavy vehicle wheel
Spokes light delivery wagon
Spokes, light and heavy vehicle
Spokes, push cart wheel
Sprags, mine
Spring bars
Spring bars, light and heavy vehicle
Spring blocks, wagon
Spring yokes, light delivery wagon
Stakes, heavy vehicle
Stakes, log car
Sweep sticks, loom
Teeth, lawn rake
Teeth, spur gears
Tongues, corn planter
Tongues, light vehicle
Tongues, wagon
Treadle sticks, loom
Trucks, warehouse
Upper head blocks, light delivery wagon
Vehicle stock
Wheelbarrows,
Wheels, vehicle
Wreckskids, railway
Whiffletrees, vehicle

HOLLY

Backs, bath brush
Blocks, brush
Cups, soap
Forks, wooden, cooking
Forks, wooden, salad
Handles, rolling pin
Mashers, potato
Paddles, butter
Pins, rolling
Spoons, wooden mixing
Sticks, toddy

HORNBEAN

Balls, duckpin
Balls, tenpin
Handles, adze
Handles, canthook
Handles, grab maul
Handles, peavy
Handles, timber carrier
Heading, nail keg
Heads, grab maul
Neck yokes
Neck yokes, jockey
Sides, cheese box
Whiffletrees

LAUREL, MOUNTAIN

Inlaid work, furniture

LANCEWOOD

Rods, fishing

LIGNUM-VITAE

Balls, lemon squeezer
Balls, lime squeezer
Bung starters
Cups, lemon squeezer
Cups, lime squeezer
Heads, mallet
Mallets, coppersmith
Mallets, printers'

LOCUST

Brackets, telegraph pole
Cross-arms, telegraphs pole
Hubs, light delivery wagon
Paper pulp
Pins, insulator
Pins, telephone

MAHOGANY

Antique furniture, exterior
Arms, chair
Balusters, stair
Back posts, chair
Base boards, house interior trim
Base moulding, house interior trim
Beams, dining room ceiling
Beds, folding, exterior
Bedsteads, exterior
Benches, piano
Book racks, revolving
Book cases, sectional
Brackets, plate rail
Brackets, stair
Cabinets, magazine
Cabinets, music
Cabinets, phonograph
Cabinets, scale
Cabinets, smokers
Cabins, interior ships
Cabins, interior, yachts
Carpet strip, house interior trim
Carvings, wood
Cases, binnacle
Cases, chart (ship)
Cases, dental
Cases, hall clock
Cases, optical
Cases, piano
Casing, door
Casing (veneered), pipe organ
Casing, window
Caskets
Cellarettes, exterior
Chair arms, sleeping coaches
Chair rail, house interior trim
Chairs, arm
Chairs, morris
Chests, hall
Chests of drawers, exterior
Chests, silverware
Cheval mirrors
Chiffoniers, exterior
Coffins
Colonnades, house interior trim
Colonnades, pullman coaches
Commodes, exterior
Consoles
Counters, bar room, exterior
Covers, switch boxes, (electric cars)
Covers, switch box (Pullman coaches)
Cupboard doors, Pullman coaches
Deck boards, automobile
Dash boards, automobile
Decking, canoe

MAHOGANY—Concluded

Decking, motor boat
Desk chairs
Door strips, automobile
Doors, folding
Doors, locker, boat and ship
Doors, ship cabin
Doors, sliding
Doors, upper berth (sleeping coaches)
Facings, window partitions (electric cars)
Filing cases, sectional
Fillet, house interior trim
Fine cabinet work
Finish, yacht cabins
Flat battens, house interior trim
Flooring, parquetry
Foot rails, stair
Foot rests
Foot stools
Frames, chair
Frames, couch
Frames, davenport
Frames, door, house interior trim
Frames, mirror
Frames, picture
Frames, settee
Frames, upholstered chair
Furniture
Furniture, office
Furniture, special period
Gauges, carpenters'
Glass front boards, automobile
Gunwales, canoe
Grilles, house interior trim
Grilles, Pullman coach
Grilles, ship cabin
Ground glass frames, camera
Hall mirror hatracks
Handles, camera slides
Handles, hand scraper
Hand rails, yacht
Head casing, house interior trim
Hubs, pilot wheels, boat and ship
Interior finish, camera
Interior finish, electric cars
Interior finish, Pullman coaches
Key bottoms, piano
Legs, piano
Legs, table
Lens boards, camera
Lids, water closet
Lunch tables, portable, pullman coaches
Mantels
Mirror doors, house
Mirror frames, passenger elevator cars
Mirror frames, pullman coaches
Mirror frames, ship cabins
Models
Models, machine
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove, house interior trim
Moulding, crown, house construction
Mouldings, piano
Mouldings, quarter round
Moulding, spring cove, house interior trim
Music shelf, piano
Newel posts, angle
Newel posts, starting
Panel strips, house interior trim
Panel wainscoting, ship cabin
Panel wainscoting, inside Pullman coaches
Panels, case
Panels, ceiling, Pullman coaches
Panels, clock case
Panels, desk
Panels, passenger elevator cars
Panels, piano cases
Panels, window, Pullman coaches
Parts, automobile bodies
Patterns
Pilasters, piano
Pillars, chair
Pilot wheels, ship
Pilot wheels, yacht
Plate holders, camera
Plate rail, dining room
Players, piano
Princess dressers
Push button frames, Pullman coaches
Rails, stair
Range finders, camera
Rims, pilot wheel (boat and ship)
Rockers, chair
Ruling machines, bookbinders
Sash, Pullman coaches
Sash, ship cabins
Screens, bank
Screens, fire
Seats, piano
Seats, water closet
Servettes, dining room table
Settee
Settles
Shelves, book
Showcases
Sides, piano case
Sills, inside window (electric cars)
Sills, window, inside (pullman coaches)
Spindles, chair
Stands, chafing dish
Stands, plant
Steering wheel rims, automobile
Stools, piano
Tables, drop leaf
Tables, tea
Tops, counter
Tops, table
Trays, jewelry display
Trays, sewing
Treads, stair
Veneer
Veneer, furniture
Veneer, piano cases
Wainscot rail, house interior trim
Wainscoting, house interior trim
Wainscoting cap, house interior trim
Wardrobes, auto-valet
Wheel trays, dining room
Window apron, house interior trim
Window stool, house interior trim

MAPLE, SOFT

Acetate of lime
Alcohol, wood
Backing, cases
Baskets
Baskets, split
Beds, folding
Blinds, porch
Blinds, venetian
Blocks, brush
Boards, hosiery
Bobbins
Bottom rails, sash
Bottoms, butter pails
Bottoms, carriage bodies
Bottoms, fruit baskets
Bottoms, wagon bodies
Box shooks
Boxes
Boxes, bottle
Boxes, comb
Boxes, creamery shipping
Boxes, knife
Boxes, plate glass packing
Boxes, salt
Boxes, tin plate
Boxes, veneer
Brooders
Brushes, wall
Brushes, window
Bureaus, enameled
Cabinet work
Cabinets, medicine
Cases, blacking
Cases, egg
Cases, liquor
Celery crates
Center arms, split wood pulleys
Chairs, children's
Chairs, kitchen
Chairs, laundry
Charcoal
Checkers
Chessmen
Cheval mirrors, enameled
Clothes racks, laundry
Chiffoniers, enameled
Clothespins
Cores, veneer
Commodes
Commodes, enameled
Costumes
Cradles
Crates, fruit and vegetable
Crates, milk bottle
Crating
Dowels, chair
Driers, towel
Dumb-waiter posts
Dusters
Flooring
Frames, chair
Frames, collapsible crates
Frames, couch
Frames, davenport
Frames, door
Frames, parlor furniture
Frames, sofa
Frames, upholstered chair
Frames, upholstered furniture
Frames, window
Furniture, case goods
Furniture, doll
Furniture, interior work
Guide rails, dumb waiter
Handles, paint brush
Handles, umbrella
Handles, whitewash brushes
Heading, slack cooperage
Heads, spool
Interior trim
Interior work, sideboard
Lapboards
Lath
Lining, case
Meeting rails, sash
Middles, spool
Moulding, picture
Mullions, sash
Novelties
Quills
Panels, door
Paper pulp
Patterns
Pedal boards, organ
Porch blinds
Rails, door
Reels, cordage mill
Reels, wire
Ruling machines, bookbinders'
Sash
Saw horses
Screens, door
Screens, window
Seats, baby carriage
Seats, chair
Shelves, book
Shelving
Shuttles
Signboards
Signs, advertising
Speeders
Spool heads
Spools
[illegible] rag
Stanchions
Staves, slack cooperage
Sticks, parasol
Sticks, umbrella

MAPLE, SOFT—Concluded.

Stiles, door
Stools, camp
Swings, porch
Tabourettes
Tables
Tables, kitchen
Top rails, sash
Toy furniture
Toy tops
Veneer
Wash benches
Wash stands, enameled

MAPLE, SUGAR

Armor backing, ship
Armor blocking, ship
Arms, chair
Arms, split-bottom chair
Axles, cornplanters
Axles, farm wagon
Axles, wagon
Back boards, piano
Back posts, chair
Backs, brush
Backs, chair
Backs, dust brushes
Backs, lawn swings
Backs, nail brush
Backs, scrubbing brush
Beds, warehouse trucks
Benches, automobile
Benches, carpenter
Benches, piano
Blocks, brake
Blocks, brush
Blocks, butchers'
Blocks, die
Blocks, chopping
Blocks, mangle roll
Blocks, pulley
Blocks, tackle
Blades, T-square (draftman's)
Boards, hosiery
Boards, meat
Boards, pie
Boards, potato chip
Boards, potato peeler
Boards, slaw
Bobbins
Bolsters, warehouse truck
Bottom boards, piano
Bottoms, automobile
Bottoms, basket
Bottoms, chair
Bottoms, coal wagon body
Bottoms, drawers
Bottoms, drawer (dental cases)
Bottoms, drawer (optical cases)
Bottoms, land roller top
Bowling alleys
Bowls
Bowls, chopping
Bows, buggy top
Bows, carriage top
Bows, wagon top
Boxes
Boxes, butter
Boxes, candy
Boxes, comb
Boxes foundry moulding
Boxes, knife
Boxes, packing
Boxes, salt
Boxes, tin plate
Brackets, mine
Brakes, electric crane
Bridges, piano
Brushes, paint
Brushes, whitewash
Budging, table sides
Bung starters
Bureaus, exterior
Bushings, cream separator
Cabinets
Cabinets, type
Canes, walking
Cars, hand
Carts, push
Cases, shipping
Cases, type
Cases, wall
Center arms, split wood pulleys
Chairs, children's
Chairs, folding camp
Chairs, rocking
Chair seats, veneered
Chase frames, printers'
Chase furniture, printers'
Children's carriages
Clamps, trouser hanger
Clocks, wall
Clothes driers
Clothes pins
Cogs, flour mill machinery
Collars, cream separator
Cores, typewriter platens
Costumers
Counters, billiard
Covers, butter tub
Crates
Crutches
Cues, billiard
Cups, soap
Decking, canal boat
Dishes, wooden
Display forms, hosiery
Display forms, shoe
Door boards, coal car
Door boards, railroad grain car
Dowels
Dowels, parasol shanks
Dumb waiters
Eveners
Faucets
Fixtures, bar room
Fixtures, barber shop
Fixtures, curtain
Fixtures, office
Fixtures, store
Flasks
Flooring, electric cars
Flooring, engine cab
Flooring, freight car
Flooring, freight car platform scales
Flooring, house
Flooring, mine dump cars
Flooring, parquetry
Flooring, passenger elevator
Flooring, railway car
Frames, blueprint
Frames, box mattress
Frames, buck saw
Frames, clothes wringers
Frames, corn sheller
Frames, cot
Frames, glass cutter
Frames, spraying machine
Frames, ten pin setter
Frames, thresher grain register
Framework, farm machinery
Friction blocks, derrick
Friction blocks, hoisting engine
Gear parts, automobile
Gear woods, threshing machine
Gauges, carpenters'
Guide strips, dumb waiter
Hammer boards, foundry
Handle cross pieces, lawn mower
Handles
Handles, awl
Handles, broom
Handles, brush
Handles, butcher knife
Handles, canthook
Handles, clothes wringer
Handles, coal pick
Handles, coal sieve
Handles, corkscrew
Handles, cross-cut saw
Handles, dust brush
Handles, fishing rod
Handles, hoe
Handles, ice cream freezer
Handles, lawn rake
Handles, mining pick
Handles, paint brush
Handles, peavy
Handles, piano
Handles, roller (bit brace)
Handles, screw driver
Handles, shoe knife
Handles, shovel
Handles, soldering
Handles, spud
Handles, timber carrier
Handles, vice
Handles, umbrella
Hangers, coat
Heading, cement barrels
Heading, cooperage
Heading, nail keg
Heading, slack cooperage
Heads, spool
Hearse tables, (burial carriage)
Interior finish
Jaws, lemon squeezer
Jaws, lime squeezer
Key bottoms, piano
Knobs, door
Knobs, furniture
Krautcutters
Lasts, shoe
Leeboards, canoe
Legs, billiard table
Legs, chiffonier
Legs, curd grinding machine
Legs, dresser
Legs, dressing table
Legs, incubator
Legs, kitchen table
Legs, table
Legs, washing machine
Lemon squeezers
Lime spreaders, gear woods
Lining, piano case
Machine rolls
Mallets
Mallets, stone cutters'
Mashers, potato
Mauls, steak
Middles, spool
Mine cars
Miter boxes, wooden
Models
Moulding, automobile
Moulds, brick
Moulds, butter
Mounting blocks, cash register (electric cars)
Mounting blocks, electrical apparatus
Novelties
Orange racks
Overhead beams, dumb waiter
Packers, flour mill machinery
Paddles, butter
Paddles, canoe
Paper pulp
Parasol sticks
Parquetry flooring
Partitions, drawer
Parts, hay press
Patterns
Pedals, pipe organ
Pin blocks, piano
Pins, cartridge
Pins, clothes
Pins, pie rolling
Pins, rolling
Pipe, wooden water
Planes, printers'
Plates, bread
Poles, curtain
Poles, tent
Porch gates
Posts, bed
Posts, chair
Posts, corn sheller
Posts, dresser
Posts, guide, freight elevator
Posts, piano
Posts, guide, passenger elevator
Posts, split bottom chairs
Press rolls, paper mill machinery
Racks
Racks, curtain display
Racks, rug display
Racks, towel
Racks, umbrella
Rails, foot, automobile
Rails, mine car
Reels, electric wire
Reels, solder wire
Refrigerators

MAPLE, SUGAR—Concluded.

Reglets, printers'
Ribs, thresher grain register
Rims, bicycle
Risers, stair
Rockers, chair
Rockers, rustic porch chairs
Rockers, split bottom chairs
Rods, chair
Roller blocks
Roller, caster
Rollers, dye
Rollers, lawn mower
Rollers, mangle
Rollers, mine
Rollers, paperhangers' seam
Rounds, chair
Runners, drawer
Sash, carriage
Seat frames, canoe
Seats, automobile
Seats, lawn swing
Show cases
Shuttles
Sides, billiard table
Sides, mine dump car
Sills, heavy wagon
Skewers, butchers'
Slats, ash can
Slats, automobile
Slats, bed
Sleds
Slides, extension table
Slides, table
Space bars, typewriter
Spools
Spoons, wooden cooking
Spoons, wooden mixing
Sprags, mine
Sprues, foundry flask
Squeezers, lime
Staffs, flag
Staves, cement barrel
Stave, cooperage
Staves, slack cooperage
Steering wheels, automobile
Sticks, dye
Sticks, flower
Straw carriers
Stretcher blocks, foundry
Stretchers, chair
Strips, guide, elevator
Sweepers, carpet
Sweeping brushes
Swings, child's
Swings, porch
Tables, library
Tenpins
Thresholds
Throats, tennis racket
Tongues, corn planter
Tongues, land roller
Tongues, wagon
Tops, table
Toy furniture
Toy ten pins
Toy tops
Traps, game
Traps, mouse
Treads, stair
Trucks
Trucks, handy
Truck sills, gas engine
Tracks, sliding seat (outriggers and racing shells)
Trunks
Turning blocks
Type, wood
Veneer
Walkers, baby
Walking sticks
Washboards
Washstands, exterior
Wheelbarrows
Wrestplanks, piano
Wringers, cloths

OAK, BLACK.

Flooring, wagon bodies

OAK, RED.

Armor backing, ship
Armor blocking, ship
Antique furniture, hidden work
Astragals, folding door
Astragals, sliding door
Axles, heavy wagon
Backs, chair
Backs, dust brush
Balusters, stair
Base blocks, house interior trim
Base boards, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Bases, dining table
Beams, dining room ceiling
Beams, plow
Bedsteads, exterior
Blind stop, house construction
Blinds, window
Blocks, brush
Bodies, automobile
Bodies, electric car
Bodies, railway cars
Bodies, wheelbarrow
Body frames, light and heavy vehicles
Bookcases, exterior
Bookcases, sectional exterior
Booths, telephone, exterior
Bottom boards, barge
Bottom boards, scow
Bottom rails, sash
Bottoms, automobile bodies
Bottoms, case goods
Bottoms, feed bag
Bottoms, grape basket
Bottoms, light delivery wagon body
Bottoms, pit cars
Bottoms, wagon seat
Boxes, plate glass packing
Boxes, telephone
Boxes, tin plate
Brackets, insulator
Brackets, plate rail
Brackets, stair
Brackets, telegraph pole
Buffets, exterior
Bureaus, exterior
Cabinets, kitchen, exterior
Cabinets, typewriter
Carpet strip, house interior trim
Carvings, interior house finish
Cases, blacking
Cases, casket
Cases, coffin
Cases, dental
Cases, optical
Cases, organ
Cases, water closet tank
Casing, door
Casing, pipe organ
Casing, window
Caskets
Ceiling
Center arms, split wood pulleys
Chair rail, house interior trim
Chairs, morris, exterior
Chests, silverware
Colonnades, house interior trim
Commodes
Consoles
Corner beads, house interior trim
Corner blocks, house interior trim
Costumers
Coupling poles, light vehicles
Cross arms, telegraph poles
Cross ties, railroad
Deck beams, canal boat
Deck beams, motor boat
Deck beams, river craft
Deck beams, ship
Deck beams, yacht
Desks, school
Doors
Doors, china closets
Doors, folding
Doors, sliding
Doors, storm
Draft timbers, freight cars
Draw beams, railway
Drop gates, light delivery wagon body
Dust cap, house interior trim
Easel blackboards
End sills, freight car
Ends, bookcase
Ends, buffet
Ends, bureau
Ends, chiffonier
Ends, desk
Ends, dresser
Felloes, wagon wheel
Fenders, ship
Fillet, house interior trim
Finish, boat
Fixtures, office (exterior)
Flasks
Flat battens, house interior trim
Flooring
Flooring, house
Foot rests, wagon
Frames, agricultural implements
Frames, barges
Frames, bucksaw
Frames, canal boat
Frames, cellar door
Frames, cellar window
Frames, collapsible crate
Frames, door
Frames, engine cab
Frames, flour mill machinery
Frames, freight car
Frames, harrow
Frames, mirror
Frames, picture
Frames, river craft
Frames, scow
Frames, ship
Frames, sieve
Frames, window
Frames, yacht
Front doors, house
Front panels, light delivery wagons
Fronts, china closets
Furniture, bedroom
Furniture, mission, exterior
Gear woods, milling machinery
Grilles, house interior trim
Grille work
Gunwales, row boat (round bottom)
Head blocks, house interior trim
Head casing, house interior trim
Heading, oil barrels
Heading, slack cooperage
Heading, tight cooperage
Hold beams, river craft
Hold beams, ship
Hold beams, yacht
Hoops, slack cooperage
Hubs, light vehicle
Interior finish
Interior finish, house
Interior trim, bar room
Inwales, row boat (round bottom)
Jambs, door
Keels, row boat, (round bottom)
Keels, canal boat
Keels, river craft
Keels, ship
Keels, yacht
Keelsons, canal boat
Keelsons, river craft

OAK, RED—Concluded.

Keelsons, ship
Keelsons, yacht
Knees, canal boat
Leaves, dining room table
Legs, billiard table
Legs, brooder
Legs, feed mill elevator
Legs, table
Lids, grape basket
Lids, water closet
Lining, light delivery wagon
Mantels
Medicine cabinets
Meeting rails, sash
Mirror doors, house
Mounting blocks, cash register (electric cars)
Moulding, bed, house interior trim
Moulding, cap, house interior trim
Moulding, cove, house construction
Moulding, crown, house construction
Moulding, electric wire
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Mullions, sash
Newel posts, angle
Newel posts, starting
Nosing, house interior trim
Novelties
Panel strips, house interior trim
Panels, door
Parquetry flooring
Partitions, office
Partitions, store
Pastry sets
Pedestals
Pedestals, table
Pews, church
Pilots, locomotive
Pins, insulator
Planking, barge
Planking, scow
Plate rail, dining room
Posts, bed
Posts, bookcase
Posts, buffet
Posts, chair
Posts, chiffonier
Posts, desk
Posts, dresser
Posts, sideboard
Pulpits, exterior
Racks, magazine
Rails, door
Rails, stair
Rails, table
Reels, electric wire
Reels, solder wire
Refrigerators
Ribs, motor boat
Ribs, row boat (round bottom)
Rims, split wood pulleys
Risers, stair
Rosettes, wall (stairway)
Runners, sleigh
Running boards, automobile
Running boards, electric cars
Sash
Screens, door
Screens, window
Seats, chair
Seats, water closet
Shelves, book
Shelves, china closet
Shelves, mantel
Shingles
Shoe rails, stair
Showcases
Sideboards, exterior
Sideboards, interior
Sides, billiard tables
Sides, case
Sides, push carts
Sides, wagon
Sills, door
Sills, gasoline engine truck
Sills, heavy wagon
Sills, log car
Sills, stone crusher
Sills, wagon
Slats, lawn seat
Sofas, exterior
Spokes, cart wheel
Spokes, light vehicle
Stanchions, canal boat
Stanchions, river craft
Stanchions, ship
Stanchions, yacht
Stands, Bible
Stands, plant
Stands, umbrella
Staves, cement barrel
Staves, oil barrel
Staves, slack cooperage
Staves, tight cooperage
Stay bars, light delivery wagon
Stems, row boat (flat bottom)
Stem posts, row boat
Sterns, row boat (round bottom)
Stern posts, row boat (round bottom)
Stiles, door
Stops, door, house interior trim
Store fronts
String boards, stair
Strips, weather
Studding, log car
Swings, porch
Tables,
Tables, extension
Tables, sewing
Tabourettes
Thresholds, house interior trim
Tillers, canal boat
Toprails, sash
Tops, table
Toy furniture
Toy tops
Transoms, row boat (round bottom)
Trays, incubator
Treads, stair
Veneer
Veneer cores, piano cases
Ventilators, window
Wainscoting
Wainscoting, cap, house interior trim
Wainscoting rail, house interior trim
Washstands, exterior
Window apron, house interior trim
Window stool, house interior trim

OAK, WHITE.

Acetate of lime
Alcohol, wood
Armor, backing, ship
Armor, blocking, ship
Arms, chair
Astragals, folding door
Astragals, sliding door
Baby tender, walking chairs
Back posts, chair
Backs, chair
Backs, church pew
Backs, vacuum cleaner brush
Balusters, stair
Bars, wooden harrow
Base board, house interior trim
Base blocks, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Baseboards
Basket parts
Beams, coal car
Beams, dining room ceiling
Beams, plow
Beater roll, paper mill machinery
Bedposts
Beds, folding
Beds, light delivery wagon
Bedsteads
Belt, light delivery wagon bodies
Benches, piano
Benches, shop
Blind stop, house construction
Blocks, brush
Blocks, thermometer
Blocks, wagon brake
Boats, row
Bodies, automobile
Bodies, mine pit wagon
Bodies, truck
Bodies, wagon
Body bolsters, freight cars
Bolsters, heavy vehicle
Bolsters, heavy wagon
Bottom boards, mine car
Bottom rails, sash
Bottoms, baggage truck
Bottoms, delivery wagon
Bottoms, ore car bodies
Bottoms, wagon
Bookcases, built-in
Bookcases, sectional
Book racks, revolving
Booths, telephone
Bows, buggy top
Bows, carriage top
Bows, lawn rake
Bows, wagon top
Boxes, bit
Boxes, blacking
Boxes, plug tobacco
Boxes, telephone
Boxes, wagon
Braces, railway car
Braces, railway car frame
Brackets, insulator
Brackets, plate rail
Brackets, telegraph pole
Brackets, telephone
Brake beams, heavy vehicle
Brake blocks, mine pit wagon
Buffets
Buffets, exterior
Buggy bottoms
Bull wheels, derrick
Bull wheel arms, oil well machinery
Bumpers, locomotive
Bumpers, traction engine
Bumping posts, railroad
Bureaus
Bureaus, exterior
Cabinet work
Cabinet work, boat cabins
Cabinets, electrical work
Cabinets, magazine
Cabinets, medicine
Cabinets, music
Cabinets, phonograph
Cabinets, phonograph record
Cabinets, smoker
Cabinets, toilet
Cabinets, towel
Cabinets, type
Cabins, boat
Cages, elevator
Capitals
Carpet strip, house interior trim
Carts, push
Carved ornaments, furniture
Carvings, interior house finish
Cases, blacking
Cases, casket
Cases, clock
Cases, dental
Cases, library
Cases, medicine
Cases, optical
Cases, piano
Cases, railroad ticket

Cases, wall
Cases, water closet tank
Casing, door
Casing, pipe organ
Casing, window
Casings
Caskets
Ceiling, boat
Ceiling, house
Cellarettes
Center arms, split wood pulley
Chair frames
Chair rail, house interior trim
Chairs
Chairs, adjustable
Chairs, arm
Chairs, dining
Chairs, invalid
Chairs, kitchen
Chairs, morris
Chairs, nursery
Chairs, office
Chairs, opera
Chairs, revolving
Chairs, rocking
Chairs, rolling
Chairs, stenographers'
Chandeliers, wooden art
Charcoal
Cheese boxes, veneer
Chests, hall
Chests of drawers
Chests, silverware
Chests, tool
Cheval mirrors
Chiffoniers, exterior work
China closets
Churn parts
Churns, butter
Chute points, freight cars
Cleats, wagon box
Clothes trees
Coaming, motor boat
Coffins
Colonnades, house interior trim
Columns, porch
Commodes
Communion rails
Consoles
Cores, veneered door
Corner beads, house interior trim
Corner blocks, house interior trim
Corner posts, light delivery wagon
Corner posts, ore car bodies
Costumers
Counters, bar
Counters, soda water, exterior
Counters, store
Couplings, farm wagon
Cradles
Cribs, child's
Cross arms, telegraph pole
Cross ties, railroad
Crossing planks, railroad
Crystal cabinets
Cue racks, billiard
Cupboards, kitchen
Deck beams, canal boat
Deck beams, motor boat
Deck beams, river craft
Deck beams, ship
Deck beams, yacht
Decking, motor boat
Desk chairs
Desks, electric switchboard
Desks, flat top
Desks, roll top
Desks, roll top, exterior
Desks, school
Door boards, coal car
Door boards, railroad grain car
Door frames, china closet
Door frames, freight car
Doors
Doors, china closet
Doors, folding
Doors, sliding
Doubletrees, vehicle
Draft beams, freight car
Draft timbers, freight car
Draw beams, railway car
Draw heads, coal car
Drawer fronts, office fixtures
Drawer sides
Drays
Dressers
Drop gates, light delivery wagon body
Drop lids, desk
Drum lagging, hoisting engine
Dump carts, bodies
Dust cap, house interior trim
Electric cars, interior finish
End panels, dresser
End sills, freight car
End sills, locomotive tender
End sills, log car
Ends, church pew
Ends, mine car bodies
Ends, pit cars
Engine beams, freight cars
Eveners, harrow
Exterior work, electric shoe shining machine
Feeding platform, rock crushing machinery
Felloes
Felloes, automobile wheel
Felloes, heavy vehicle wheel
Fence pickets
Fenders, boat
Fenders, river craft
File cases
Filing cases, sectional
Fillet, house interior trim
Finish, boat
Finish, interior engine cab
Fireless cookers, exterior
Fixtures, bank
Fixtures, bar
Fixtures, barber shop
Fixtures, curtain
Fixtures, laboratory
Fixtures, office
Fixtures, store
Fixtures, store display
Flat battens, house interior trim
Flooring, automobile bodies
Flooring, boats
Flooring, freight cars
Flooring, hardwood
Flooring, house
Flooring, light delivery wagon
Flooring, parquetry
Foot rests
Foot stools
Forebays, flour mill
Frames, agricultural implements
Frames, automobile bodies
Frames, barge
Frames, bobsleds
Frames, canal boat
Frames, chair
Frames, coal screen
Frames, cold storage door
Frames, couch
Frames, davenport
Frames, dump cars
Frames, dump carts
Frames, electric cars
Frames, electric switchboard
Frames, engine cab
Frames, freight car
Frames, gravel screens
Frames, hall clock
Frames, hand coffee mill
Frames, hand mirror
Frames, harrow
Frames, light vehicle
Frames, light vehicle body
Frames, lounge
Frames, mirror
Frames, mission hall clock
Frames, motor boat
Frames, picture
Frames, quarry car
Frames, river craft
Frames, sand shaking screen
Frames, scow
Frames, ship
Frames, surrey body
Frames, tobacco truck
Frames, truck body
Frames, truck sleigh
Frames, upholstered chair
Frames, upholstered furniture
Frames, vessel
Frames, wagon body
Frames, wood-boring machines
Frames, wood-saw
Frames, yacht
Front bolsters, wagon
Front doors, house
Front hounds, wagon
Front panels, light delivery wagon
Fronts, china closet
Fronts, drawer
Fronts, dresser
Furniture, bank
Furniture, bar room
Furniture, barber shop
Furniture, case goods
Furniture, craftman's
Furniture, drug store
Furniture, office
Furniture, store
Gates, freight elevator
Gear parts, wagon
Gear wood, light wagon
Grilles
Grilles, house interior trim
Guards, boat
Gunwales, boat
Gunwales, canoe
Gunwales, row boat, (round bottom)
Hall mirror hat racks
Hall racks
Handles
Handles, axe
Handles, barrow
Handles, coal pick
Handles, coal shovel
Handles, cultivator
Handles, edge-tool
Handles, hand axe
Handles, machine
Handles, mattock
Handles, mop
Handles, paint brush
Handles, pick
Handles, planters' eye hoe
Handles, plow
Handles, push cart
Handles, railroad pick
Handles, saw
Handles, spading fork
Hand rails, river craft
Hatracks
Head blocks, house interior trim
Head casing, house interior trim
Heading, oil barrel
Heading, slack cooperage
Heading, tight cooperage
Heading, whiskey barrel
Heel board, light delivery wagon
High chair, child's
Hind bolsters, wagon
Hind hounds, wagon
Hold beams, river craft
Hold beams, ship
Hold beams, yacht
Hoops, slack cooperage
Horns, phonograph
Hounds
Hounds, heavy wagon
Hounds, wagon
Hubs, heavy vehicle wheel
Hubs, push cart wheel
Hubs, wagon
Hulls, boat
Ice chest, outside finish
Interior finish
Interior finish, house
Interior finish, electric cars
Inwales, row boat, (round bottom)
Jambs, door
Joiners, deck
Keel blocks, boat
Keels, canal boat
Keels, motor boat
Keels, river craft
Keels, row boat (round bottom)
Keels, ship
Keels, yacht

OAK, WHITE—Continued.

Keelsons, canal boat
Keelsons, river craft
Keelsons, ship
Keelsons, yacht
Kitchen cabinets, exterior
Kitchen safes
Knees, canal boat
Knees, river craft
Knees, ship
Knees, yacht
Knobs, door
Knobs, furniture
Ladders, gymnasium
Ladders, hay
Ladders, river craft
Ladders, ship
Ladders, tobacco
Lagging
Leaves, table
Legs, billiard table
Legs, chair
Legs, desk
Legs, dresser
Legs, piano
Legs, sink
Legs, table
Lids, water closet
Light vehicle bodies
Lining, elevator car
Lower panels, light delivery wagon bodies
Mantels
Mantels, soda fountain
Manure spreaders
Medicine cabinets
Meeting rails, sash
Milk counters, dairyman's
Mine cars
Mine trucks
Mirror cases
Mirror doors, house
Mirrors, adjustable shaving
Mission furniture
Models, machine
Moulding, automobile
Moulding, bed, house interior trim
Moulding cap, house interior trim
Moulding, cove, house construction
Moulding, crown, house construction
Mouldings, piano
Mouldings, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Mounting boards, telegraph instruments
Mug cases, barber shop
Mullions, sash
Music shelf, piano
Nosing, house interior trim
Novelties
Organ cases
Organs, cabinet
Organs, pipe
Overhead beams, dumb waiters
Overhead beams, freight elevators
Paddle wheels, excursion boats
Panel strips, house interior trim
Panel work, display windows
Panel work, store fixtures
Panels, bed
Panels, door
Panels, stair work
Parallel bars, gymnasium
Parlor cabinets, exterior
Partition moulds, house interior trim
Partitions, office
Partitions, store
Parts, cultivator
Parts, wood sawing machine
Passenger cars, frames
Pastry sets
Patterns
Pedestals
Pew book racks
Pews, church
Picker sticks, loom
Pilasters, furniture
Pilasters, mantel
Pilasters, piano
Pillars, chair
Pilots, locomotive
Pilot wheels, river craft
Pilot wheels, ship
Pilot wheels, yacht
Pins, insulator
Plant stands
Platforms, ten pin setters
Platforms, freight cars
Plate rail, dining room
Plate racks
Play yards, baby
Players, piano
Plow beams
Plow handles
Plow parts
Plows
Poison cases, drug store
Poles, curtain
Poles, farm machinery
Poles, light vehicle
Poles, wagon
Porch swings
Posts, buffets
Posts, carriage body
Posts, chair
Posts, heavy wagon body
Posts, railway car frame
Posts, traction engine cab
Posts, wagon body
Press, tennis racket
Princess dressers
Pulpits, church
Racks, billiard ball
Racks, coat
Racks, display
Racks, key
Rails, bed
Rail, billiard table
Rails, boat
Rails, chiffonier
Rails, china closet
Rails, door
Rails, dresser
Rails, stair
Rails, table
Rails, truck
Rails, wagon
Reaches, buggy
Reaches, heavy vehicle
Reaches, heavy wagon
Reaches, lumber wagon
Reaches, perch spring wagon
Reaches, surrey
Reading desks, church
Rear end posts, light delivery wagon
Reed organs, exterior work
Reels, cable
Reels, wire rope
Refrigerators
Ribs, row boat
Ribs, row boat (round bottom)
Ribs, motor boat
Ribs, wagon top
Rims
Rims, automobile wheel
Rims, buggy wheel
Rims, heavy vehicle wheel
Rims, sieve
Rims, split wood pulleys
Rings, necktie
Rocker frames
Rockers, chair
Rockers, porch chair (rustic)
Rockers, toy
Rollers, field
Rollers, home trainers
Road carts, bottom boards
Rounds, chair
Rounds, plow
Row boats, parts
Rudders, ship
Rudders, yacht
Rudders, river craft
Rungs, chair
Rungs, ladder
Runners, sleigh
Running boards, locomotive
Sand boards, game
Sand boards, wagon
Sash
Scows, frames
Screens, fire
Seat boards, light delivery wagon
Seats, automobile car
Seats, hall
Seats, piano
Seats, water closet
Seats, wire frame chair
Secretaries, exterior
Serving tables
Settee
Settles
Sewing machine parts
Shafts, dump cart
Sheathing
Shelves, book
Shelves, china closet
Shelves, mantel
Shelves, table
Shelving, china closet
Showcase
Shuffleboards
Sideboards, exterior
Sideboards, built-in
Side pillars, light delivery wagon
Side slats, light delivery wagon
Side stakes, freight car
Sides, billiard table
Sides, dump wagon body
Sides, parlor settle
Sides, pit car
Sides, table
Sides, truck
Sidings, boat
Siding, mine car
Sills, automobile body
Sills, carriage
Sills, freight car
Sills, gasoline engine truck
Sills, light delivery wagon
Sills, railway car
Sills, stone crusher
Sills, truck
Sills, vehicle body
Sills, wagon
Sills, wagon body
Singletrees (vehicle)
Slats, automobile
Slats, bed
Sleds, toy
Sofas, exterior
Sofa frames, (upholstered furniture)
Spindles, chair
Splints, surgical
Spokes, automobile wheel
Spokes, heavy vehicle wheel
Spokes, wagon
Spokes, wagon wheel
Spring bars
Spring blocks, railway cars
Spring blocks, railway tank cars
Stanchions
Stanchions, boat
Stanchions, canal boat
Stanchions, river craft
Stanchions, ship
Stanchions, wagon top
Stanchions, yacht
Standards, chiffonier
Standards, dressing table
Stands
Stands, bedroom
Stands, Bible
Stands, chafing dish
Stands, city directory
Stands, flower
Stands, hall (exterior)
Stands, jardiniere
Stands, lamp
Stands, typewriter
Stands, umbrella
Stands, water cooler
Staves, land roller drum
Staves, oil barrel
Staves, slack cooperage
Staves, tight cooperage stock
Staves, water tank
Staves, whiskey barrel
Stay bars, light delivery wagon
Stays, boat
Stems, canal boat

OAK, WHITE—Concluded

Stems, motor boat
Stems, river craft
Stems, ship
Stems, yacht
Steps, stairwork
Stern posts, canal boat
Stern posts, motor boat
Stern posts, river craft
Stern posts, row boats
Stern posts, row boats (round bottom)
Stern posts, ship
Stern posts, yacht
Stiles, door
Stools, office
Stools, piano
Stops, door, house interior trim
Straw carriers
Stretchers, chair
Stretchers, table
Stringers, railway car
Studding, log car
Superstructure, launches
Sway bars, wagon
Sweep sticks, loom
Swing cleats, curtain pole
Swings, lawn
Swings, porch
Switchboards, telephone
Switch timbers, railroad
Tables
Table slides
Tables, billiard
Tables, dining
Tables, dressing
Tables, drop leaf
Tables, extension
Tables, folding
Tables, library
Tables, lunch room
Tables, parlor
Tables, sewing
Tables, tea
Tables, typewriter
Tables, writing
Tabouretts
Tail boards, wagon
Tank cases, water closet
Tanks
Tanks, brewery
Tanks, distilling
Tanks, diving (theatrical)
Thresholds
Thresholds, house interior trim
Tie beams, cars
Ties, railroad track
Tight cooperage stock
Tillers, canal boat
Tillers, river craft
Tongues, cultivator
Tongues, corn planter
Tongue hounds, wagon
Tongues, heavy wagon
Top rails, light delivery wagon bodies
Top rails (sash)
Tops, chair
Tops, counter
Tops, dresser
Tops, table
Tops, wire frame tables
Toy furniture
Toy tops
Trays, jewelry display
Trays, sewing
Transoms, row boat (round bottom)
Treadle sticks, loom
Tree blocks, shoe
Truck bolsters, freight car
Trucks
Trucks, freight car
Trucks, stevedore
Vats, beer
Vats, oil
Vehicle (gear parts)
Veneer
Veneer, furniture
Veneered doors, craftsman
Ventilators, window
Vestment cases, church
Wagons, diamond drill
Wainscoting
Wainscoting caps, house interior trim
Wainscoting (elevator cars)
Wainscoting rail, house interior trim
Wall cases
Wardrobes (exterior)
Washers, fire escape construction
Washstands, exterior
Wedges, foundry
Wheels, water mill
Windlass frames, derrick
Window apron, house interior trim
Window screens
Window sills
Window stool, house interior trim

OLIVEWOOD

Backs, clothes brush
Pipes, smoking

PEARWOOD

T-squares, drawing

PERSIMMON

Handles, brick trowel
Heads, golf clubs
Lasts, shoe
Shuttles

PINE, LOBLOLLY

Backing, furniture
Balusters (stair)
Barn boards
Battens, o. g. barn
Beams, o. h. (elevator)
Beams, ship
Bevel cribbing
Blowers, organ
Blowers, player piano
Boat construction
Boards, lopping
Bottom rails, sash
Bottoms, bank fixtures
Bottoms, office fixtures
Bottoms, store fixtures
Box shooks
Boxboards, heavy vehicles
Boxes
Boxes, bottle
Boxes, coffee
Boxes, dry goods
Boxes, feed cutter
Boxes, packing
Boxes, root cutters
Boxes, trunk
Boxes, weight (dumb waiter)
Boxes, weight (elevator)
Brackets, stair
Cabinets
Car decking
Car siding
Cases, casket
Cases, clock
Cases, shipping
Casing
Ceiling
Ceiling, traction engine cabs
Clapboards
Coffins
Cores, veneer
Cornice
Cornice, house construction
Crates, beer
Crates, cabbage
Crates, milk bottle
Crating
Cross arms, telegraph pole
Cross-ties, railroad
Cupboards, built in
Decking, freight cars
Doors
Doors, freight car
Excelsior
Excelsior, packing
Excelsior, ribbon (mattress stuffing)
Facia boards, freight cars
Fallow boards, foundry
Fencing
Fixtures
Fixtures, office
Fixtures, store
Flooring
Flooring, porch
Flooring, wagon bed
Frames, coal screens
Frames, door
Frames, gravel screen
Frames, passenger car
Frames, sand shaking screens
Frames, window
Fruit jar cases
Gates, freight elevator
Guide rails (dumb waiter)
Hand rails, stair
Heading, slack cooperage
Insulator pins
Interior finish
Interior finish, house
Interior trim, house
Lath
Lining, dumb waiter shaft
Lining, freight cars
Lockers
Meeting rails, sash
Mouldings
Moulding, bed, house construction
Moulding, crown, house construction.
Moulding, crown, house construction.
Moulding, picture
Mullions, sash
Newel posts, angle
Newel posts, starting
Nosing, interior house trim
Panels, door
Paper pulp
Partition, house
Patterns (foundry)
Planking, ship
Platforms, carriage hoist
Platforms (elevator)
Poles, tent
Porch work
Rails, door
Rails, stair

LOBLOLLY PINE—Continued

Risers, stair
Roof ribs, freight cars
Roofing, house
Rosettes, wall (stair)
Rough horses (stairway)
Safes, kitchen
Sash
Screens, door
Screens, window
Sheathing
Shelves, dumb waiter
Shelves, mantel
Shelving
Shiplap
Shoe rails, stair
Side boards, wheelbarrow
Sides, corn sheller
Slats, bed
Staves, slack cooperage
Stiles, door
String boards (stair)
Superstructure, electric cars
Top rails, sash
Treads, stair
Wainscoting
Weight boxes (elevator)

PINE, LONGLEAF

Astragals, folding door
Astragals, sliding door
Backing, counters
Balusters, porch
Balusters, stair
Barn boards
Barge construction
Base blocks, house interior trim
Baseboards
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Bases, gasoline engine
Battens, dumb waiter
Battens, o. g. barn
Bay brackets, house construction
Beams, derrick
Beams, dining room ceiling
Beams, elevator
Beds, coal wagon
Beds, light delivery wagons
Bevel cribbing
Bevel siding, house
Blind stops, house construction
Blinds, window
Blocking, railway tank cars
Bodies, manure spreader
Bodies, railway cars
Bodies, sugar corn cars
Booms, river craft
Booms, ship
Bottom rails (sash)
Bottom rail, porch
Bottoms, dump cart
Bottoms, heavy vehicle
Bottoms, lawn swings
Bottoms, light vehicles
Bottoms, push carts
Boxboards, dump carts
Boxboards, wagon
Box shooks
Boxes, lime and fertilizer sewers
Braces, freight car
Brackets, plate rail
Brackets, porch
Brackets, stair
Bridge poles (car)
Cabinet work
Cabinets (dental)
Cabinets, jewelry
Cabinets, (toilet)
Cabins, canal boats
Cabins, exterior, river craft
Cabins, exterior, ships
Cabins, exterior, yachts
Capitals
Capping, sink, house interior trim
Carpet strips, house interior trim
Cars, dumb waiter
Cars, elevator
Cart beds
Cases, china
Cases, medicine
Cases, tobacco
Casing, door
Casing, window
Ceiling
Chair rail, house interior trim
Cleats, dumb waiter
Climbing poles, gymnasium
Colonnades, house interior trim
Consoles
Corner beads, house interior trim
Corner blocks, house interior trim
Corner posts, freight cars
Cornice, house construction
Cores, veneer doors
Cores, veneer panels
Covers, ice freezing can
Covers, tank
Cradles, tank cars
Crates, cabbage
Cresting, porch roof
Cross-arms
Cross-ties, railroad
Deck beams, boat
Decking, freight cars
Decking, canal boats
Decking (ship and boat)
Derricks, oil well
Doors, dumb waiter shaft
Doors, folding
Doors, railway box cars
Doors, sliding
Dumb waiter
Dust cap, house interior trim
Elevators (freight)
Elevators (passenger)
Eveners
Face brackets, house construction
Fencing
Fillet, house interior trim
Finish, boats
Finish, caboose interior
Fixtures, bar room
Fixtures, barber shop
Fixtures, cafe
Fixtures, laboratory
Fixtures, office
Fixtures, store
Flat battens, house interior trim
Flooring, automobile
Flooring, engine cab
Flooring, freight cars
Flooring, freight elevators
Flooring, house
Flooring, locomotive tender
Flooring, passenger elevators
Flooring, porch
Flooring, refrigerator cars
Flooring, scale platforms
Footing pieces (elevator)
Forms, sewer
Frames, awning
Frames, barge
Frames, box car
Frames, couch
Frames, door
Frames, front door side light
Frames, log turners
Frames, motor boat hulls
Frames (passenger cars)
Frames, railroad snow plows
Frames, road scrapers
Frames, scow
Frames, store truck
Frames, window
Framing, freight car
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Guides, mine shaft
Guide rails, dumb waiter
Gunwales, row boat (flat bottom)
Hand cars
Hand cars, railway
Hand rails, stair
Hay beam, farm wagon
Hay ladders, farm wagon
Hay rake posts
Head blocks, boat
Head blocks, house interior trim
Head blocks, tank cars
Head casing, house interior trim
Header posts
Heading, slack cooperage
Ice boxes
Interior finish
Jambs, door
Keel strips, row boat (flat bottom)
Keelsons, river craft
Keelsons, ship
Keelsons, yacht
Ladders, exterior
Ladders, step
Lath
Lattice
Lids, water closet
Lining cars
Lining, freight cars
Lining, light delivery wagon
Lining, box cars
Long sills, freight cars
Mantels
Manure spreaders
Meeting rails (sash)
Mirror doors, house construction
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Mountings, rock crushers
Mullions, sash
Needle beams (railway car frames)
Newel posts, angle
Newel posts, starting
Nosing, house interior trim
Ornaments, furniture
Overhead beams, dumb waiter
Panel strips, house interior trim
Panels, door
Panels, stair work
Panels, veneered
Paper pulp
Parting strips, house interior trim
Partition, house
Partition moulds, house interior trim
Parts, milling machinery
Parts, railway motor car
Pianos, interior parts
Planking, boat
Planking, canal boat
Plates, freight cars
Plate rail, dining room
Plates, electric car
Plates, freight cars
Plates, passenger cars
Platforms, freight elevator
Platforms, passenger elevator
Platforms, tank
Plugs, cross-tie
Plumber's woodwork
Poles, farm implements
Poles, flag

PINE, LONGLEAF—Concluded

Poles, land rollers
Poles, tent
Poles, wagon
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrel
Posts, freight cars
Push cars
Racks, rug display
Rails, door
Rails, river craft
Railway car construction
Reels, cable
Reels, wire rope
Refrigerators
Refrigerators, outside
Ridge poles, freight cars
Risers, stair
Risers, row boat (flat bottom)
Roof framing, silos
Roof ribs, freight cars
Roofing, box cars
Roofing, freight cars
Roofing, house
Rosettes, wall (stairway)
Rough horses, stair
Running boards, locomotive
Sash
Scales
Scoop boards
Scows
Screens, door
Screens, window
Scroll sawed balusters, porch
Seat boards, light delivery wagon
Seats, rowboat
Seats, water closet
Sheathing
Shelves
Shelves, mantel
Shiplap
Shoe rails, stair
Show cases
Shutters
Sideboards, built in
Side planks(gondola cars)
Side plates
Side plates (railway freight cars)
Sides, coal flats
Sides, dumb waiter
Siding
Siding, box cars
Siding, caboose
Siding, freight car
Signboards
Signs, advertising
Sills, door
Sills, electric cars
Sill, freight car
Sills, railway car
Sills, window
Silos
Sink aprons, house interior trim
Slats, bed
Slats, railway cattle cars
Slide, fly screen
Snow boards, engine pilot
Spindles, porch
Stakes, gondola cars
Staves, silo
Staves, slack cooperage
Stems, canal boat
Stem posts, row boat
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
String boards, stair
Stringers, railway car
Studding
Supports, elevator
Supports, tank
Swings, lawn
Swings, porch
Tackle blocks
Tanks
Tanks, acid
Tanks, paper mill
Tanks, pickling
Thresholds
Thresholds, house interior trim
Tillers, canal boat
Tillers, river craft
Tongues, agricultural machinery
Tongues, farm machinery
Tongues, manure spreaders
Tongues, wagon
Top rail, porch
Top rails (sash)
Tops, freezing tank
Tops, land rollers
Treads, stair
Trunks
Upper belt rails (freight cars)
Upright, row boats (flat bottom)
Vats
Wainscot rail, house interior trim
Wainscoting
Wainscoting cap, house interior trim
Wall cases
Water tanks, railroad
Window apron, house interior trim
Window stool, house interior trim
Wire cloth display racks

PINE, NORWAY

Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, o. g. barn
Bay brackets, house construction
Beams, dining room ceiling
Blind stops, house construction
Bottom rail, porch
Bottom rail, sash
Brackets, plate rail
Brackets, porch
Cabs, locomotive
Capping, sink, house interior trim
Carpet strips, house interior trim
Casing, door
Casing, window
Chair rail, house interior trim
Colonnades, house interior trim
Corner blocks, house interior trim
Consoles
Cresting, porch roof
Door battens, freight car
Doors, folding
Doors, sliding
Face brackets, house construction
Fillet, house interior trim
Flasks, foundry
Flat battens, house interior trim
Flooring, freight cars
Frames
Frames, front door side light
Frames, window
Frieze rail, porch
Front doors, house
Gable brackets, house construcstruction
Gable ornaments, house construction
Grilles, house interior trim
Head blocks, house interior trim
Heading, plate glass shipping cars
Jambs, door
Lattice
Mantels
Meeting rail, sash
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Mullions, sash
Nosing, house interior trim
Parting stop, house interior trim
Partition moulds, house interior trim
Panels, door
Panel strips, house interior trim
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch, spandrels
Rails, door
Roof strips, freight car
Scroll sawed balusters, porch
Sink aprons, house interior trim
Slide, fly screen
Spindles, porch
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
Top rail, porch
Top rails, sash
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

PINE, PITCH

Bottom boards, farm wagon bodies
Box shooks
Boxes, packing
Boxes, soap
Cornice, house construction
Crating
Flats, hay wagon
Flooring, house
Pallets, fire brick
Wainscoting, house construction

PINE, SCRUB

Battens, o. g. barn
Box shooks
Boxes, packing
Cases, packing
Casing, door
Casing, window
Crating
Excelsior
Flooring
Flooring, porch
Flooring, railway cars
Frames, door
Frames, front door side light
Frames, mirror
Frames, picture
Frames, window
Paper pulp
Roofers
Running boards, electric car
Scroll sawed balusters, porch
Siding, barn
Thresholds

PINE, SHORTLEAF

Astragals, folding door
Astragals, sliding door
Balusters, porch
Balusters (stair)
Barn boards
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, o. g. barn
Bay brackets, house construction
Beams, dining room ceiling
Beds, farm wagon
Bevel cribbing
Bevel siding, house
Blind stop, house construction
Boards, lapping
Booms, river craft
Booms, ship
Bottom boards, foundry flask
Bottom boards, row boat
Bottom rails, porch
Bottom rails (sash)
Box boards
Box shooks
Boxes, feed cutter
Boxes, packing
Boxes, soap
Brackets, plate rail
Brackets, porch
Brackets, stair
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, window
Casing, door
Ceiling
Chair rail,, house interior trim
Colonnades, house interior trim
Consoles
Corner beads, house interior trim
Corner blocks, house interior trim
Cornice
Cornice, house construction
Covers, tank
Crating
Cresting, porch roof
Cross arms, telegraph pole
Cross-ties, railroad
Decking (cars)
Doors
Doors, folding
Doors, freight cars
Doors, sliding
Dust cap, house interior trim
Face brackets, house construction
Fallow boards, foundry
Fencing
Fenders, boat and ship
Fillet, house interior trim
Flasks, foundry
Flat battens, house interior trim
Floor boards, truck
Floor boards, wagon
Flooring, freight cars
Flooring, house
Flooring, incubators
Flooring, locomotive tender
Flooring, porch
Frames, cellar window
Frames, cold storage doors
Frames, door
Frames, front door side light
Frames, land rollers
Frames, lawn swings
Frames, window
Framing, freight cars
Framing, passenger cars
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Gunwales, row boat (flat bottom)
Hand cars
Hand rails (stair)
Handles, brush
Handles, long handled dust brush
Handles, mop
Handles, wall brush
Hatch covers, river craft
Hatch covers, ship
Hatch covers, yacht
Head blocks, house interior trim
Head casing, house interior trim
Heading, slack cooperage
Insulation (refrigerator cars)
Jambs, door
Keel strips, row boats (flat bottom)
Ladders, river craft
Ladders, ship
Ladders, step
Lath
Lattice
Lining, box cars
Lining (cars)
Lining, railway car
Lining, railway freight cars
Mantels
Meeting rails (sash)
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, electric wire
Moulding, quarter round
Moulding, picture
Moulding, plaster, house construction
Moulding, screen
Moulding, spring cove, house construction
Mullions (sash)
Newel posts, angle
Newel posts, starting
Nosing, house interior trim
Panels (door)
Panels, stair work
Panel strips, house interior trim
Paper pulp
Parting strip, house interior trim
Partition, house
Partition moulds, house interior trim
Parts, butter workers
Plate rail, dining room
Planking, yacht
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrel
Props, clothes
Rails (door)
Reels, cable
Reels, wire rope
Refrigerators
Risers, row boat (flat bottom)
Risers, stair
Roof boards, silo
Roofing, box cars
Roofing, freight cars
Roofing, house
Roofing, railway car
Roofing, railway freight cars
Rosettes, wall (stairway)
Rough horses (stairway)
Sash
Screens, door
Screens, window
Scroll sawed balusters, porch
Seats, automobile
Seats, row boat
Sheathing
Sheathing, house
Shelves, mantel
Shelving
Shiplap
Shoe rails (stair)
Siding, barn
Siding, box cars
Siding, dredge
Siding, freight cars
Siding, house
Siding, railway car
Sink aprons, house interior trim
Slide, fly screen
Spindles, porch
Staves, slack cooperage
Stiles (door)
Stops, door, house interior trim
Stops, window, house interior trim
String boards (stair)
Stringers, railway cars
Timbers, ship
Top rail, porch
Top rails (sash)
Treads, stair
Uprights, row boat (flat bottom)
Wainscoting
Wainscoting cap, house interior trim
Wainscot rail, house interior trim
Window apron, house interior trim
Window stool, house interior trim
Transoms, row boat

PINE, SUGAR

Astragals, folding door
Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, o. g. barn
Bay brackets, house construction
Beams, dining room ceiling
Blind stop, house construction
Bottom rail, porch
Bottom rails, sash
Boxing, pipe organ
Brackets, plate rail
Brackets, porch
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, door
Chair rail, house interior trim
Colonnades, house interior trim
Consoles
Corner blocks, house interior trim
Cresting, porch roof
Doors, folding
Doors, sliding
Dust cap, house interior trim
Face brackets, house construction
Fillet, house interior trim
Flat battens, house interior trim
Frames, door
Frames, front door side light
Frames, pipe organ
Frames, window
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim

PINE, SHORTLEAF—Concluded

Head blocks, house interior trim
Head casing, house interior trim
Mullions, sash
Jambs, door
Lattice
Mantels
Meeting rail, sash
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Nosing, house interior trim
Panel strips, house interior trim
Panels, door
Parting stop, house interior trim
Partition moulds, house interior trim
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, solid
Porch spandrels
Rails, door
Scroll sawed balusters, porch
Sills, pipe organ
Sink aprons, house interior trim
Slide, fly screen
Spindles, porch
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
Swell boxes, pipe organ
Top rail, porch
Top rails, sash
Wainscot rail, house interior trim
Wainscoting, cap, house interior trim
Wind chests, pipe organ
Window apron, house interior trim
Window stool, house interior trim

PINE, WESTERN YELLOW

Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, o. g. barn
Bay brackets, house construction
Beams, dining room ceiling
Blind stop, house construction
Bottom rails, sash
Bottom rail, porch
Brackets, plate rail
Brackets, porch
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, door
Casing, window
Chair rail, house interior trim
Colonnades, house interior trim
Consoles
Corner blocks, house interior trim
Cresting, porch roof
Cross-ties, railroad
Doors, folding
Doors, sliding
Dust cap, house interior trim
Face brackets, house construction
Fillet, house interior trim
Flat battens, house interior trim
Frames, door
Frames, window
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Jambs, door
Head blocks, house interior trim
Head casing, house interior trim
Lattice
Mantels
Meeting rails, sash
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, screen
Moulding, spring cove, house construction
Mullions, sash
Nosing, house interior trim
Panel strips, house interior trim
Panels, door
Parting strips, house interior trim
Partition moulds, house interior trim
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Rails, door
Scroll sawed balusters, porch
Sink aprons, house interior trim
Slide, fly screen
Spindles, porch
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
Top rail, porch
Top rails, sash
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

PINE, WESTERN WHITE

Astragals, folding door
Astragals, sliding door
Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, o. g. barn
Bay brackets, house construction
Beams, dining room ceiling
Blind stop, house construction
Bottom rail, porch
Brackets, plate rail
Brackets, porch
Capping, sink, house interior trim
Carpet strips, house interior trim
Casing, door
Casing, window
Chair rail, house interior trim
Colonnades, house interior trim
Consoles
Corner blocks, house interior trim
Cresting, porch roof
Cross-ties, railroad
Doors, folding
Doors, sliding
Dust cap, house interior trim
Face brackets, house construction
Fillet, house interior trim
Flat battens,, house interior trim
Frieze rail, porch
Front doors, house
Frames, door
Frames, front door side light
Frames, window
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Head blocks, house interior trim
Head casing, house interior trim
Jambs, door
Key bottoms, piano
Mantels
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, plaster, house construction
Moulding, screen
Moulding, spring cove, house construction
Nosing, house interior trim
Panel strips, house interior trim
Parting stop, house interior trim
Partition moulds, house interior trim
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Scroll sawed balusters, porch
Sink aprons, house interior trim
Slides, fly screen

PINE, WESTERN WHITE—Continued.

Spindles, porch
Stops, door, house interior trim
Stops, window, house interior trim
Top rail, porch
Veneer cores, piano cases
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

PINE, WHITE

Astragals, folding door
Astragals, sliding door
Backs, buffets
Backs, bureau
Backs, china closets
Backs, mirror
Balusters, porch
Balusters (stair)
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Battens, o. g. barn
Bay brackets, house construction
Beams, dining room ceiling
Beds, light delivery wagon
Beds, sled
Bee hives
Bins, flour
Bins, grain
Bins, mill feed
Blind stop, house construction
Blinds, window
Blocks, toy wagon
Boards, drawing
Boards, lapping
Boats, row
Bodies, wagon
Bottom boards, coal flats
Bottom boards, barge
Bottom boards, foundry flasks
Bottom boards, row boat
Bottom boards, scow
Bottom rail, porch
Bottoms, dredge
Bottoms, farm wagon bodies
Bottoms, grape basket
Bottoms, leaf tobacco cases
Bottoms, threshing machine
Bottoms, toy wagons
Bottoms, toy wheelbarrows
Box shooks
Box shooks, tobacco
Boxes, battery
Boxes, entomological
Boxes, packing
Boxes, plant
Boxes, shoe
Boxes, trunk
Boxes, weight (elevator)
Brackets, plate rail
Brackets, porch
Brackets, stair
Brackets, telegraph pole
Brake locks, mine car
Brooders
Bull wheel carts, oil well machinery
Bungs
Bushel crates
Cabin finish, canal boats
Cabins, canal boats
Cabins, exterior, river craft
Cabin exterior, ships
Cabin, exterior, yachts
Capping, sink, house interior trim
Carpet strip, house interior trim
Cases, coffin
Cases, organ
Cases, packing
Cases, sample
Cases, tobacco
Cases, tool
Casing, door
Casing, window
Caskets, exterior
Chair rail, house interior trim
Chests, clothes
Cider mills
Colonial columns
Colonnades, house interior trim
Consoles
Corner blocks, house interior trim
Cornice work
Crating
Crates, bee
Cresting, porch roof
Cross-ties, railroad
Decking, yacht
Doors, dumb-waiter shafts
Doors, fire
Doors, folding
Doors, freight cars
Doors, sliding
Doors, stable
Drain boards, sink
Drain boards, soda fountain
Dust cap, house interior trim
Ends, leaf tobacco cases
Excelsior
Cross arms, telegraph pole
Face brackets, house construction
Facia boards, freight cars
Fillet, house interior trim
Flasks
Flat battens, house interior trim
Flooring
Flooring, carriage bodies
Flooring, collapsible crates
Flooring, engine cabs
Flooring, freight cars
Flooring, incubators
Flooring, mine dump cars
Flooring, road scrapers
Folding frames, baby bath tub
Forms, concrete
Frames, door
Frames, front door side light
Frames, mirror
Frames, picture
Frames, tobacco
Frames, window
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Gable ornaments, house construction
Grilles, house interior trim
Guide posts, elevator
Gunwales, boat
Hatch covers, canal boats
Hatch covers, river craft
Hatch covers, ship
Hatch covers, yacht
Head blocks, house interior trim
Head casing, house interior trim
Heading, plate glass shipping case
Heading, tight cooperage
Heading, slack cooperage
Hoppers, feed mill elevators
Hoppers, mill feed
Hoppers, flour
Hoppers, grain
Icing vats, dairyman's
Interior finish, house
Insulation (railway refrigerator cars)
Jambs, door
Jambs (elevator)
Joiner bulkheads, ship
Joiners, deck (ship)
Keels, canal boat
Keels, river craft
Keels, ship
Keels, yacht
Lids, grape basket
Lining, cast iron pipe for coal mines
Lining, dumb waiter shafts
Lining, light delivery wagon
Lining (railway box cars)
Lap siding, house
Lattice
Mantels
Matches
Mirror doors, house
Models, machine
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Moulds, brick
Moulds, foundry
Newel posts, angle
Newel posts, starting
Nosing, house interior trim
Organs, interior parts
Pails, candy
Panel strips, house interior trim
Panels, stair work
Panels, wagon bodies
Paper pulp
Parting stop, house interior trim
Partition moulds, house interior trim
Patterns
Patterns, rubber factory
Pipe organs, interior parts
Pipe, wooden, water
Pipes, organ
Planking, barge
Planking, river craft
Planking, scow
Planking, ship
Planking, yacht
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Posts, elevator
Presses, cider
Props, clothes
Rails, stair
Reels, cable
Reels, wire rope
Risers, stair
Rollers, land
Roof strips, freight car
Rosettes, wall (stairway)
Rough horses, stair work
Rudders, river craft
Rudders, ship
Rudders, yacht
Running boards, freight cars
Screens, door
Screens, window
Scroll sawed balusters, porch
Scows, coal
Scows, sand
Seat boards, light delivery wagon
Seats, row boat
Shelves, dumb-waiter
Shelving
Shoe rails (stair)
Sides (dumb-waiter)
Sides, engine cabs
Sides, farm wagon bodies

PINE, WHITE—Continued

Sides, leaf tobacco cases
Sides, mine dump cars
Sides, river barges
Sides, row boat
Sides, threshing machine
Sides, wagon boxes
Siding, barge
Siding (freight box cars)
Siding, house
Siding (railway cattle cars)
Siding, railway coaches
Silos
Sink aprons, house interior trim
Slide, fly screen
Spindles, porch
Stakes, mine
Stakes, surveyors'
Staves, slack cooperage
Stools, bench
Stops, door, house interior trim
Stops, window, house interior trim
Store fronts
String boards (stair)
Taffy sticks, confectioners'
Tanks
Templates
Tool boxes, stone crusher
Top rail, porch
Top slats, light delivery wagon bodies
Tops, leaf tobacco cases
Toy carts
Toy furniture
Treads, stair
Trunks
Vats
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Wheels, water mill
Wind chests, pipe organ
Window apron, house interior trim
Window stool, house interior trim
Work boards, bar room

POPLAR, YELLOW

Actions, piano players
Antique furniture, hidden work
Apparatus parts (electric)
Armor boxes, steel foundry
Automobile bodies
Backing, furniture
Backing, mirror
Backing, refrigerators
Backs, bureau
Backs, carriage seat
Backs, clock case
Backs, china closet
Backs, dental cases
Backs, hat brush
Backs, mirror
Backs, piano
Backs, toy pianos
Backs, wagon seats
Balusters, porch
Balusters (stair)
Base blocks, house interior trim
Base boards, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Baskets, fruit and vegetable
Bay brackets, house construction
Beds, light delivery wagon
Bedsteads
Bellows, organ
Benches, wash
Bevel siding, house
Blinds
Blind stop, house construction
Blinds, window
Blocks, brush
Blocks, hat
Blowers, organ
Blowers, player piano
Boards, bosom
Boards, lap
Boards, lapping
Boards, wash
Bobbins
Bobs, fishing
Bodies, buggy
Bodies, carriage
Bodies, cart
Bodies, dump wagon
Bodies, hearse
Bodies, toy automobiles
Bodies, wagon
Bottom boards, wagon bodies
Bottom rail, porch
Bottom rails (sash)
Bottoms, boys' express wagons
Bottoms, buggy bodies
Bottoms, buggy seats
Bottoms, carriage bodies
Bottoms, clock case
Bottoms, drawer
Bottoms, light vehicle bodies
Boxboards, heavy vehicles
Box shooks
Boxes, bottle
Boxes, butter
Boxes, cake
Boxes, coal sieve
Boxes, cracker
Boxes, creamery shipping
Boxes, macaroni
Boxes, packing
Boxes, plug tobacco
Boxes, wagon
Boxes, weight (elevator)
Braces, boat wheel
Brackets, plate rail
Brackets, porch
Brackets, stair
Brushes
Brushes, dust
Bungs
Bureaus
Butter workers, dairyman's
Cabinets
Cabinets, dental
Cabinets, medicine
Cabinets, scale
Cabinets, towel
Cabinets, type
Cabins, canal boats
Cabins, exterior, river craft
Cabins, exterior, ships
Cabins, exterior, yachts
Cab parts, locomotive
Cabs, locomotive
Capping, sink, house interior trim
Carpet strips, house interior trim
Cars, ensilage
Cases, blacking
Cases, casket
Cases, clock
Cases, dental
Cases, liquor
Cases, optical
Cases, packing
Cases, silverware
Casing
Casing, door
Casing, window
Ceiling
Ceiling, boats
Chair rail, house interior trim
Chairs, barber
Chairs, kitchen
Chests, organ
Chiffoniers
China closets, interior
Cigar boxes
Clog soles (shoes)
Coffins
Colonial columns
Colonnades, house interior trim
Commodes
Compartments, trunk
Consoles
Cores, veneer
Corner blocks, house interior trim
Cornice
Costumers
Counters, store
Crates, beer
Crates, fruit and vegetable
Crates, mineral water
Cresting, porch roof
Cupboards, kitchen
Cushion frames, vehicle
Doors
Desks, interior work
Display forms, hosiery
Display forms, shoe
Doors, folding
Doors, sliding
Drawers, interior
Drain boards, sink
Dressers
Drip boards
Dust cap, house interior trim
Elevators, corn
Elevators, feed mill
Elevators, flour mill
Electric cars, interior finish
Excelsior
Excelsior, packing
Excelsior, ribbon (mattress stuffing)
Face brackets, house construction
Faucets
Fillet, house interior trim
Finish, boats
Firkins
Fixtures, bank
Fixtures, bar
Fixtures, display windows
Fixtures, laboratory
Fixtures, office
Fixtures, store
Flasks, foundry
Flat battens, house interior trim
Foot boards, wagon
Front panels, light delivery wagons
Fronts, kitchen cabinets
Frames, billiard table
Frames, camera
Frames, coal sieves
Frames, couch
Frames, davenport
Frames, door, house construction
Frames, mirror
Frames, lounges
Frames, organ interior
Frames, picture
Frames, upholstered furniture
Frames, window
Frieze rail, porch
Front doors, house
Furniture (hidden work)
Furniture, inside
Gates, farm
Gable brackets, house construction
Gable ornaments, house construction
Grain drills, parts
Grilles, house interior trim
Hand rails, porch
Handles, machine brushes
Head blocks, house interior trim
Head casing, house interior trim
Header parts
Holders, Christmas tree
Hoppers, flour mill machinery
Ice boxes
Interior finish, house
Interior finish, pipe organ
Jambs, door
Jambs (elevator)
Keels, boat
Key bottoms, piano
Lath
Lids, water closet
Lining, light delivery wagons
Lining, refrigerator
Lining, telephone boxes
Litter carriers
Lodge furniture

POPLAR, YELLOW—Continued

Mantels
Mantels (painted work)
Meeting rails (sash)
Mirror doors, house
Mixers, dough
Models
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, piano case
Moulding, picture
Moulding, plaster, house construction
Moulding, porch
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Music cabinets, interior
Mullions (sash)
Novelties
Newel posts, angle
Newel posts, starting
Organ parts, interior
Outside finish (electric cars)
Packing cases
Paddle wheels excursion boats
Pails, candy
Panel strips, house interior trim
Panel sides, passenger cars
Panels, veneer
Panel work, wagon sides
Paper pulp
Panels, automobile bodies
Panels, auto-truck bodies
Panels, carriage bodies
Panels, coach
Panels, delivery wagon
Panels (door)
Panels, furniture sides
Panels, light wagon bodies
Panels, stair work
Panels, truck sleigh bodies
Panels, vehicle bodies
Panels, wagon bodies
Parting strip, house interior trim
Partitions
Partitions, wagon
Parts, cider mill
Parts, flour mill machinery
Parts, railway motor cars
Passenger cars, interior work
Patterns
Pedestals
Peel blades
Piano parts, interior
Pilasters, mantel
Pins, clothes
Pipe organs, interior parts
Pipes, organ
Pipes (pipe organ)
Plate rail, dining room
Poles, yarn
Pool tables, hidden work
Porch blinds
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch posts
Porch spandrels
Posts (elevator)
Posts, porch
Pulpits, church
Pumps
Quill boards
Racks, display
Racks, roller towel
Rails (door)
Rails, porch
Rails, stair
Rails, table
Reed organs, interior parts
Reels, electric wire
Reels, solder wire
Refrigerators
Refrigerators, exterior
Rims, split wood pulleys
Risers, stair
Rollers, farm machinery
Rosettes, wall (stairway)
Ruling machines, bookbinders'
Running boards, automobile
Sash
Screens, door
Screens, window
Scroll sawed balusters, porch
Seat backs, buggy
Seats, buggy
Seats, automobile
Seats, car
Seats, carriage
Seats, water closet
Sewing machine parts
Shelving
Shelves, book,
Shelves, cabinet
Shelving, dental case
Shoe rails (stair)
Show cases
Shuttles
Sideboards, built in
Sides, drawer
Sides, farm machinery
Sides, flour mill machinery
Sides, threshing machine
Sides, wagon bodies
Sides, wagon box
Siding
Siding, house
Siding, passenger cars
Siding, railway freight cars
Sidings (wagon beds)
Sidings, wagon
Sink aprons, house interior trim
Slide, fly screen
Spars, boat
Spindles, porch
Spools
Spouting, flour mill
Staging, boats
Staves, cement barrels
Staves, slack cooperage
Steps, step ladder
Stiles, door
Stops, door, house interior trim
Stops, window, house interior trim
Straw carriers
String boards (stair)
Strips, weather
Tables, cafe
Tables, dining
Tables, enameled library
Tables, kitchen
Tables, lunch room
Tabourettes
Top boards (pipe organs)
Top rail, porch
Top rails (sash)
Top slate, light delivery wagon bodies
Tops, table
Toy carts
Toy furniture
Toy tops
Toy wagons
Transoms, row boat
Traps, mouse
Traveling cases
Trays, trunk
Treads, stair
Troughs, bakers'
Trunk boxes
Type cases
Upper panels, light delivery wagon bodies
Vegetable slicers
Veneer
Veneer cores, organ cases
Veneer cores (piano cases)
Veneer crossbanding
Wainscot rail, house interior trim
Wainscoting, outside (railway cars)
Wainscoting cap, house interior trim
Walkers, baby
Wardrobes
Wardrobes, inside finish
Wheelbarrows
Window apron, house interior trim
Window stool, house interior trim
Wood pulleys
Wood rolls, paper mill machinery

RATTAN

Stocks, whip

REED

Stocks, whip

REDWOOD

Astragals, folding door
Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Bay brackets, house construction
Beams, dining room ceiling
Bevel siding, house
Bottom rail, porch
Brackets, porch
Brackets, porch rail
Carpet strip, house interior trim
Casing, door
Casing, window
Caskets
Cases, coffin
Cases, casket
Chair rail, house interior trim
Coffins
Corner blocks, house interior trim
Cornice
Cresting, porch roof
Cross-ties, railroad
Doors, sliding
Dust cap, house interior trim
Face brackets, house construction
Fillet, house interior trim
Flat battens, house interior trim
Frieze rail, porch
Gable brackets, house construction
Gable ornaments, house construction
Head blocks, house interior trim
Head casing, house interior trim
Incubators
Jambs, door
Mirror doors, house

REDWOOD—Concluded.

Moulding, bed, house construction
Molding, brick, house construction
Molding, cap, house interior trim
Molding, cove
Molding, crown, house construction
Moulding, drip, cap, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Nosing, house interior trim
Panel strips, house interior trim
Parting stops, house interior trim
Patterns
Plate rail, dining room
Porch columns, built up
Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Ruling machines, bookbinders
Screens, door
Screen, window
Scroll sawed balusters, porch
Shade hangers
Siding, freight car
Spindles, porch
Staves, silo
Stops, window, house interior trim
Stops, door, house interior trim
Store fronts
Top rail, porch
Trays, incubator
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

ROSEWOOD.

Backs, clothes brush
Backs, hair brush
Backs, nail brush
Blocks, brush
Bottlestoppers
Clubs, policeman
Frames, mirror
Frames, picture
Gavels
Handles, drawing instruments
Handles, surgical instruments
Levels, masons
Panels, automobile bodies
Parts (automobile bodies)
Pilot wheels, ship
Pilot wheels, yacht
T-Squares (drawing)
Veneer

SASSAFRAS.

Knees, row boat
Knees, river craft
Knees, ship
Knees, yacht

SPRUCE.

Balusters (stair)
Bevel siding, house
Bodies, electric cars
Bodies, railway cars
Booms, river craft
Booms, ship
Bottom boards, barge
Bottom boards, foundry flasks
Bottom boards, row boat
Bottom boards, scow
Bottom rail, sash
Boxes, bottle
Boxes, packing
Brackets, stair
Bridges, piano
Cases, packing
Ceiling, ship cabin
Cornice, house
Crating
Cross arms, telegraph pole
Cross-ties, railroad
Diagonal sweeps, piano
Easels, school blackboard
Flasks
Flasks, foundry
Flooring, electric cars
Flooring, freight cars
Flooring, mine dump cars
Flooring, railway passenger cars
Frames, blackboard
Frames, cold storage door
Frames, dumb waiter
Frames, window
Gunwales, canoe
Gunwales, row boat (flat bottom)
Hatch covers, river craft
Hatch covers, ship
Hatch covers, yacht
Interior trim, house
Interior work, canal boat cabins
Keel strips, row boat (flat bottom)
Key bases, piano
Ladders, extension
Ladders, river craft
Ladders, ship
Ladders, step
Lath
Leeboards, canoe
Lining, refrigerator
Masts, river craft
Masts, ship
Meeting rails, sash
Mullion, sash
Newel posts, angle
Newel posts, starting
Oars, row boat
Packing cases, plate glass
Paddles, canoe
Planking, barge
Planking, canoe
Planking, railway cars
Planking, scow
Poles, tent
Rails, stair
Reels, cable
Reels, wire rope
Refrigerators
Ribs, piano
Risers, row boat (flat bottom)
Risers, stair
Rosettes, wall (stairway)
Rough horses(stairway)
Running boards (electric cars)
Sash, window
Scaffolding (painters)
Sides, mine dump cars
Sides, row boat
Sounding board ribs, piano
Sounding boards, piano
Spars (ship)
Staves, tight cooperage
Stays, boat
String boards (stair)
Studding (ship building)
Tanks, wooden
Top rails, sash
Transoms, row boat
Treads, stair
Uprights, row boat (flat bottom)

SPRUCE, SITKA.

Balusters, porch
Base blocks, house interior trim
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Beams, dining room ceiling
Blind stops, house construction
Bottom rails, porch
Brackets, plate rail
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, window
Chair rail, house interior trim
Colonnades, house interior trim
Corner blocks, house interior trim
Cornice work, house
Cresting, porch roof
Decking, boat
Doors, folding
Doors, sliding
Dust cap, house interior trim
Fillet, house interior trim
Flat battens, house interior trim
Frames, door
Frames, front door side light
Frames, window
Frieze rail, porch
Front doors, house
Gable brackets, house construction
Head blocks, house interior trim
Head casing, house interior trim
Jambs, door
Keels, boat
Mirror doors, house
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, drip cap, house construction
Moulding, picture
Moulding, quarter round
Moulding, spring cove, house construction
Nosing, house interior trim
Panel strips, house interior trim
Parting stop, house interior trim
Partition moulds, house interior trim
Plate rail, dining room
Porch columns, built up

SPRUCE SITKA—Concluded.

Porch columns, solid
Porch newels, built up
Porch newels, solid
Porch spandrels
Scroll sawed balusters, porch
Seats, boat
Siding, house
Sink aprons, house interior trim
Slide, fly screen
Spars, ship
Spindles, porch
Stops, door, house interior trim
Stops, window, house interior trim
Top rail, porch
Wainscoting cap, house interior trim
Wainscoting rail, house interior trim
Window apron, house interior trim
Window stool, house interior trim
Poles, tent
Rails, stair
Reels, cable
Reels, wire rope
Refrigerator
Ribs, piano

SUMACH.

Inlaid work, furniture

SYCAMORE.

Base blocks, house interior trim trim
Base board, house interior trim trim
Base corners, house interior trim
Base moulding, house interior trim
Basket parts
Baskets, fruit
Baskets, vegetable
Beams, dining room ceiling
Blind stop, house construction
Blocks, butcher
Boat parts
Bottoms, drawer
Boxes, packing
Boxes, plug tobacco
Brackets, plate rail
Buckets
Cabinet work
Cabins, interior, ships
Cabins, interior, yacht
Capping, sink, house interior trim
Carpet strip, house interior trim
Cases, reed organ
Casing, door
Casing, window
Chair rail, house interior trim
Chairs
Colonnades, house interior trim
Consoles
Cooperage stock
Corner blocks, house interior trim
Crating
Doors, folding
Doors, sliding
Dust cap, house interior trim
Fillet, house interior trim
Fixtures, office
Fixtures, store
Flat battens, house interior trim
Frames, door
Frames, front door side light
Frames, window
Front doors, house
Furniture, case goods
Gable ornaments, house construction
Grilles, house interior trim
Handles, hoe
Handles, rake
Handles, saw
Head blocks, house interior trim
Head casing, house interior trim
Hoppers, fruit
Hoppers, vegetable
Jambs, door
Lath
Mantels
Meat blocks
Mirror doors, house
Moulding, bed, house construction
Moulding, brick, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, picture
Moulding, plaster, house construction
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Nosing, house interior trim
Packages, fruit
Packages, vegetable
Pails, candy
Panel strips, house interior trim
Paper pulp
Parting stop, house interior trim
Partition moulds, house construction
Parts, washing machine
Plate rail, dining room
Reed organs, interior parts
Refrigerators
Sides, drawer
Sink aprons, house interior trim
Slide, fly screen
Stools, foot
Stops, door, house interior trim
Stops, window, house interior trim
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim
Veneer
Venetian blinds

TAMARACK.

Base blocks, house construction
Base board, house interior trim
Base corners, house interior trim
Base moulding, house interior trim
Beams, dining room ceiling
Blind stop, house construction
Brackets, plate rail
Capping, sink, house interior trim
Carpet strip, house interior trim
Casing, door
Casing, window
Chair rail, house interior trim
Ceiling, house
Colonnades, house interior trim
Corner blocks, house interior trim
Cross-ties, railroad
Doors, folding
Dust cap, house interior trim
Excelsior
Fillet, house interior trim
Flat battens, house interior trim
Flooring, boats
Flooring, house
Frames, door
Frames, front door side light
Frames, window
Front doors, house
Grilles, house interior trim
Head casing, house interior trim
Head blocks, house interior trim
Jambs, door
Keels, boat
Knees, canal boat
Knees, river craft
Knees, ship
Knees, yacht
Lath
Mirror doors, house
Moulding, bed, house construction
Moulding, cap, house interior trim
Moulding, cove
Moulding, crown, house construction
Moulding, picture
Moulding, quarter round
Moulding, spring cove, house construction
Nosing, house interior trim
Panel strips, house interior trim
Partition moulds, house construction
Parting stop, house interior trim
Plate rail, dining room
Silos
Sink aprons, house interior trim
Slide, fly screen
Stem pieces (boat)
Stem posts, river craft
Stem posts, ship
Stem posts, yachts
Stems, river craft
Stems, yachts
Stems, ships
Stops, door, house interior trim
Stops, window, house interior trim
Stringers, boat
Tanks
Tubs
Wainscot rail, house interior trim
Wainscoting cap, house interior trim
Window apron, house interior trim
Window stool, house interior trim

TEAKWOOD.

Armor backing, ship
Armor blocking, ship
Cabins, interior, ship
Cabins, interior, yacht
Rails, yacht
Rails, ship building

TUPELO.

Cigar boxes

WALNUT, BLACK.

Altars, church
Arms, chair
Back posts, chair
Backs, clothes brush
Backs, hair brush
Backs, nail brush
Balusters (stairway)
Base board, house interior trim
Base moulding, house interior trim
Beams, dining room ceiling
Beds, folding exterior
Bedsteads, exterior
Benches, piano
Bible stands, church
Blocks, brush
Bookcases, exterior
Book racks, revolving
Brackets, plate rail
Cabins, interior ships
Cabins, interior, yachts
Cabinet making
Cabinets, electrical work
Cabinets, magazine
Cabinets, phonograph
Cabinets, smokers
Carpet strip, house interior trim
Cases, casket
Cases, clock
Cases, coffin
Cases, dental
Cases, hall clock
Cases, optical
Cases, organ
Cases, piano
Cases, reed organs
Casing, door
Casing, pipe organ
Casing, window
Cellarettes
Chair arms, Pullman coaches
Chairs, arm
Chair rail, house interior trim
Chairs, morris
Chests, hall
Chests, medicine
Chests of drawers, exterior
Cheval mirrors
Chiffoniers, exterior
Commodes, exterior
Colonnades, house interior trim
Colonnades, Pullman coaches
Consoles
Covers, switch box, Pullman coaches
Cupboard doors, Pullman coaches
Dash boards (automobile)
Deck boards, automobile
Desk chairs
Doors, sliding
Doors, folding
Doors, upper birth (sleeping cars)
Dust cap, house interior trim
Fillet, house interior trim
Finish, interior (automobile bodies)
Flat battens, house interior trim
Flooring, parquetry
Foot rests
Foot stools
Fore ends, gun
Frames, mirror
Frames, picture
Furniture, church
Grilles, house interior trim
Grilles, pullman coaches
Hall mirror hatracks
Handles, rolling pin
Handles, saddlers' tool
Hand rails, stairway
Head casing, house interior trim
Heads, carpenter squares
Heads, T-squares (draftsman)
Interior finish, Pullman cars
Legs, piano
Lunch tables, portable, pullman coaches
Mirror doors, house
Mirror frames, pullman coaches
Moulding, bed, house construction
Moulding cap, house interior trim
Moulding picture
Moulding, quarter round
Moulding, screen
Moulding, spring cove, house construction
Mouldings, piano
Music shelf, piano
Nosing, house interior trim
Panel strips, house interior trim
Panel wainscoting, Pullman coaches
Panels, case
Panels, ceiling, Pullman coaches
Panels, desk
Panels, window, Pullman coaches
Patterns
Pews, church
Pilasters (piano)
Pillars, chair
Pilot wheels, ship
Pilot wheels, yacht
Plate rail, dining room
Princess dressers, exterior
Push button frames, Pullman cars
Rockers, chair
Sash, Pullman coaches
Screens, fire
Seats, piano
Settees
Settles
Sewing machine parts
Shelves, book
Showcases
Spindles, chair
Stands, chafing dish
Sticks, toddy
Stocks, air rifle
Stocks, gun
Stools, piano
Stops, window, house interior trim
Tables, dining room
Tables, dropleaf
Tables, exterior
Tables, library
Tables, parlor
Tables, tea
Throats, tennis racket
Tops, counters
Trays, serving
Veneer
Veneer, piano cases
Wainscot rail, house interior trim
Wainscoting, house interior trim
Wainscoting cap, house interior trim
Wall cases
Window apron, house interior trim
Window stool, house interior trim

WALNUT, CIRCASSIAN.

Beds, exterior
Bureaus, exterior
Cabins, exterior, ships
Cabins, interior, yachts
Case work
Chiffoniers, exterior
Dash boards, automobile
Fore ends, gun
Frames, picture
Panels, bedstead
Panels, case
Panels, desk
Piano cases, veneer
Stocks, gun
Veneer

WEICHSEL ROOTS.

Canes, walking
Handles, parasol
Handles, umbrella
Stems, smoking pipes

WILLOW.

Bats, baseball
Pails, candy
Pulp, paper

MANUFACTURERS.

The names and addresses of the wood users furnishing the information for this report have been listed in arrangement and order corresponding with the industries appearing in the preceding pages. Where the name of a manufacturer is given in several industries it is because he manufactures commodities belonging to more than one industry.

AGRICULTURAL IMPLEMENTS

Hertzler & Zook Co., Belleville
The A. B. Gaston Co., Cochranton
Nonpareil Mfg. Co., Cochranton
A. G. Anchey's Sons, Codorus
Doylestown Agricultural Co., Doylestown
Hobson & Co., Easton
A. Buck's Sons Co., Elizabethtown
Theo. J. Ely Mfg. Co., Erie
George T. Sellers, Gap
Hamburg Plow Works, Hamburg
Hanover Bending and Mfg. Co., Hanover
Musser Lbr. Co., Marietta
J. H. Albright & Sons, Mifflinburg
Mountville Mfg. Co., Mountville
Miller Mfg. Co., Meyersdale
Weaver & Co., New Oxford
J. W. Connor, Orangeville
C. P. Fox, Perkasie
S. L. Allen & Co., Fifth St. & Glenwood Ave., Philadelphia
Philadelphia Lawn Mower Co., Thirty-first & Chestnut Sts., Philadelphia
Handle & Excelsior Co., Picture Rocks
Ellis Keystone Agl. Works, Pottstown
I. T. Zerbe, Reamstown
Wm. H. Fisher, Rebuck
Noah C. Stabley, Red Lion
Messinger Mfg. Co., Tatamy
Frank A. Rockwell, Troy
Frick Co., Waynesboro
John A. Hart, West Lebanon
A. B. Farquhar Co., Ltd., York
Hench & Dromgold, York
Keystone Farm Machine Co., York
The Spangler Mfg. Co., York
York Novelty Co., York

BASKETS AND VENEER PACKAGES FOR FRUIT AND VEGETABLES

Pape-Glair Wood Products Co., Brockwayville
Pease & Covell, Conneautville
J. B. Steel & Co., Coudersport
W. R. Wilcox, Lawrenceville
E. T. Steele & Sons, 1228 Irwin Ave., N. S., Pittsburgh
H. E. McConnell, Torpedo

BOARDS—CLOTH, HOSIERY, ETC.

A. H. Balliet, Allentown
J. T. Hammond & Son, Inc., 4534 Hedge St., Frankford Sta., Philadelphia
Herman Miller, 214-216 W. Dauphin, Philadelphia
Joseph T. Pearson, Kensington Ave., Cor. E. Boston, Philadelphia
Phila. Packing Box Co., 2634 American St., Philadelphia
Bethlehem Steel Co., South Bethlehem

BOOT AND SHOE FINDINGS

George E. H. Halliwell, 2451 Kensington Ave., Philadelphia
Philadelphia Last and Pattern Co., 316-18 Cherry St., Philadelphia
S. S. Redifer & Co., 139 Race St., Philadelphia
Redifer's Last Works, 237 N. Fourth St., Philadelphia
William C. Root, 524 Race St., Philadelphia

BOXES AND CRATES, PACKING

Geo. M. Wechter, Akron
Allentown Packing Box Co., Allentown
Allentown Reed, Harness and Mill Supply Co., Allentown
The Yeager Furniture Co., Allentown
Penn. R. R. Co. (Foundries), Altoona
The Autocar Co., Ardmore
Ingersoll Rand Co., Athens
Beaver Falls Planing Mill Co., Beaver Falls
J. L. McLaughlin & Sons, Bedford
Bullock Swing and Chair Mfg. Co., Inc., Bellefonte
P. B. Cridler & Son, Bellefonte
Penn. Match Co., Bellefonte
Blairsville Enameled Ware Co., Blairsville
Columbia Plate Glass Co., Blairsville
James Gardner, Jr., Co., Bolivar
West Penn. Steel Co., Brackenridge
Braddock Machine and Mfg. Co., Braddock
Pitts Machine Tool Co., Braddock
Blaisdell Machinery Co., Bradford
Consolidated Window Glass Co., Bradford
I. F. March's Sons, Bridgeport
Bristol Patent Leather Co., Bristol
Standard Cast Iron Pipe and Foundry Co., Bristol
Brockway Machine Bottle Co., Brockwayville
Greer & Garroway, Butler
Pittsburgh Hickson Co., Butler
Standard Plate Glass Co., Butler
Phoenix Novelty Co., Cambridge Springs
Nufer Cedar Co., Canonsburg
The Belmar Mfg. Co., Canton
Minnequa Furniture Co., Canton
American Welding Co., Carbondale
Carbondale Machine Co., Carbondale
H. Adler Co., Carnegie
Superior Steel Co., Carnegie
A. C. Kelly, Center Moreland
C. B. Corry & Son, Center Road Sta.
Chambersburg Engineering Co., Chambersburg
Geo. A. Minnick & Son, Chambersburg
Pittsburgh Plate Glass Co., Charleroi
American Steel Foundries, Chester
Federal Steel Foundry Co., Chester
James M. Hamilton, Chester
Davis Lumber and Planing Mill, Christiana
Gearhart Knitting Machine Co., Clearfield
Harbison Walker Refractories Co., Clearfield
Lukens Iron and Steel Co., Coatesville
Freed Heater Co., Inc., Collegeville
The Keeley Stove Co., Columbia
N. H. Goodsell, Coudersport
Penn Furniture Co., Conneautville
Shamburg & Allen Mch. Co., Coraopolis
Pittsburgh Plate Glass Co., Creighton
Dallastown Furniture Co., Dallastown
Merchant Cigar Box Co., Dallastown
Pioneer Steam Cigar Box Factory, Dallastown
H. L. Heiser, Denver
Downingtown Mfg. Co., East Downingtown
Hobson & Co., Easton
Pittsburgh Meter Co., East Pittsburgh
Westinghoue Elec. and Mfg. Co., East Pittsburgh
Westinghouse Machine Co., East Pittsburgh
C. E. Myers, East Prospect
The Eddystone Mfg. Co., Eddystone
Tindel-Morris Co., Eddystone
C. Prouty & Co., Eldred

BOXES AND CRATES, PACKING—Continued

A. Buck's Sons Co., Elizabethtown
F. W. Crandall & Co., Elkland
The Constable Bros. Co., Erie
Theo. J. Ely Mfg. Co., Erie
Erie City Mfg. Co., Erie
Exhibition Showcase Co., Erie
A. B. Feljemaker Organ Co., Erie
Lovell Mfg. Co., Erie
H. N. Thayer Co., Erie
Washburn Mfg. Co., Erie
Smith & Spahr, Etters
W. C. Laderer, Evans City
Gray & Son Glass Co., Falls Creek
Nufer Cedar Co., South Sharon, Farrell P. O.
Felton Cigar Box Factory, Felton
Pittsburgh Plate Glass Co., Ford City
Wm. Shimer Son & Co., Freemansburg
Girard Wrech Mfg. Co., Girard
Allegheny Plate Glass Co., Glassmere
Pittsburgh Steel Foundry, Glassport
Enterprise Furniture Co., Glen Rock
S. R. Smith Co., Grantham
Greensburg Glass Co., Greensburg
Greensburg Swing Co., Greensburg
The Kelly & Jones Co., Greensburg
McKay Carriage Co., Grove City
Hamburg Plow Works, Hamburg
H. E. Bair & Co., Hanover
Hanover Cabinet Co., Hanover
Hopkins Mfg. Co., Hanover
Long Furniture Co., Hanover
The W. O. Hickok Mfg. Co., Harrisburg
Union Planing Mill Co., Harrisburg
Atkinson Box and Lumber Co., Hawley
Hawthorn Bottle Co., Hawthorn
Boyd Shick, Hawthorn
S. M. Kann, Hellam
Prairie State Incubator Co., Homer City
Wyman Kimble Planing Mill, Honesdale
The L. C. Hasinger Co., Indiana
W. S. Wilcox, Jamestown
T. H. Hazlett Lumber Co., Jeannette
Pennsylvania Rubber Co., Jeannette
Union Planing Mill and Lumber Co., Jeannette
The Lorain Steel Co., Johnstown
Holgate Bros. Co., Kane
Kane Blind and Screen Co., Kane
Kane Flint Bottle Co., Kane
Kane Window Glass Co., Kane
Pennsylvania Window Glass Co., Kane
The Kittanning Plate Glass Co., Kittanning
Samuel E. Bailey, Lancaster
Benner Mfg. Co., Inc., Lancaster
Inland City Cigar Box Co., Lancaster
Lancaster Leaf Tobacco Case Co., Lancaster
Geo. E. Wisner, Lancaster
Dairymen's Supply Co., Lansdowne
Herrman Aukam & Co., Lebanon
Lebanon Valley Furniture Co., Lebanon
Miller Organ and Piano Co., Lebanon
H. M. Stauffer, Leola
A. F. Heim Carriage Works, Lenhartsville
D. M. Nesbit, Lewisburg
Oneida Community, Ltd., Lititz
Geo. R. Julius & Bros., Littlestown
New York Standard Slate Works, Lynnport
Crescent Bottle Co., McDonald
Nufer Cedar Co., McKeesport
W. S. Russell Box and Lumber Co., McKees Rocks
The Penn Box Co., Inc., McSherrystown
Hires Condensed Milk Co., Malvern
Musser Lumber Co., Marietta
Masontown Glass Co., Masontown
Reznor Mfg. Co., Mercer
Mifflinburg Body and Gear Co., Mifflinburg
Ruhl & Watson, Millmont
C. A. Swetland, Mills
T. W. Waterhouse, Mill Village
West Branch Novelty Co., Milton
E. G. Werner & Sons, Mohnton
Opalite Tile Co., Monaca
Monessen Box Factory, Monessen
Montgomery Table Works, Montgomery
Crandall-Bennett-Porter Co., Montoursville
Willson-Bennett-Porter Co., Montoursville
Spring Brook Lumber Co., Moosic
Robinson Mfg. Co., Muncy
Sprout, Waldron & Co., Muncy
S. Liebovitz & Sons, Myerstown
Nazareth Paper Box Co., Nazareth
The New Castle Box Co., New Castle
New Holland Machine Co., New Holland
Commercial Box Co., New Kensington
S. J. Bailey, Nicholson
W. K. Gresh & Sons, Norristown
Norris Pattern and Machine Co., Norristown
The Eclipse Co., North Girard
National Transit Co. Shops, Oil City
Oil Well Supply Co., Oil City
United Lumber and Coal Co., Oil City
Wightman Glass Co., Parkers Landing
Trethaway Bros., Parsons
Patton Clay Mfg. Co., Patton
The Pen Argyle Clock Case Co., Pen Argyle
Martin & Co., Petersburg
The Albro-Clem Elevator Co., Seventh St. and Glenwood Ave., Philadelphia
American Cuckoo Clock Co., 1665 Ruffner St., Philadelphia
American Steel Foundries, Fifth and Highland Aves., Philadelphia
The Baldwin Locomotive Works, 500 North Broad St., Philadelphia
James Barker, Inc., Sixth and Cayuga, Philadelphia
The Belber Trunk and Bag Co., 1641 N. Hancock St., Philadelphia
Bodenstein & Kuemmerle, Inc., Lawrence St. and Girard Ave., Philadelphia
J. G. Brill Co., Sixty-second and Woodland Aves, Philadelphia
Carlson Wenstrom Mfg. Co., 2555-59 N. Sydenham St., Philadelphia
Carmarth Bell & Co., 613-15 Cherry St., Philadelphia
James W. Cooper Co., 1706-20 Washington Ave., Philadelphia
Chas. F. Datz Co., Inc., 482-84 N. Fifth St., Philadelphia
D. H. Davidson, 2005 Washington Ave., Philadelphia
Paul H. Deigendesch, 145 Florist St., Philadelphia
Devlin & Heron, 225 N. Juniper St., Philadelphia
Estate John Galbraith, 619 Commerce St., Philadelphia
Conrad Gottlieb, 64 N. Fourth St., Philadelphia
J. T. Hammond & Son, Inc., 4534 Hedge St., Frankford Sta., Philadelphia
Edw. Harrington Son & Co., Seventeenth and Callowhill Sts., Philadelphia
Samuel Jones & Sons, 2230 Hamilton St., Philadelphia
William J. Kees, 111 N. Orianna St., Philadelphia
Ferdinand Keller, 216-24 S. Ninth St., Philadelphia
Keystone Box Mfg. Co., 701-05 East Girard St., Philadelphia
Geo. W. Kugler & Sons Co., Inc., 919 New Market St., Philadelphia
A. H. & F. H. Lippincott, Inc., Twenty-fourth and Locust Sts., Philadelphia
T. B. Luzier & Son, 1645 N. Tenth St., Philadelphia
J. & W. McCauley, 636-38 Filbert St., Philadelphia
John Martin, 1436 N. 6th St., Philadelphia
John Maxwell Estate, 425 Locust St., Philadelphia
Geo. Meisle & Bro., 217 New St., Philadelphia
S. B. Mench, 2031 E. Fletcher, Philadelphia
Joseph Miles, River Road, Manayunk Sta., Philadelphia
Thos. Mills & Bro., Inc., 1301 N. Eighth St., Philadelphia
William Myers, Quarry St., Philadelphia
Clayton W. Nichols, 918 Beach St., Philadelphia
Page & Rainy, 230 S. Second St., Philadelphia
Joseph T. Pearson, Kensington Ave., Cor. E. Boston, Philadelphia
Pennsylvania Box and Lumber Co., American and Cumberland, Philadelphia
Frank Pettit Ornamental Iron Works, 809 Master St., Philadelphia
Philadelphia Packing Box Co., 2634 American St., Philadelphia
Provident Lumber Co., Water & Dickinson Sts., Philadelphia
T. B. Rice & Sons Co., Mifflin St. Wharf, Philadelphia
Scott Paper Co., Seventh and Glenwood Ave., Philadelphia
Isaac A. Sheppard & Co., Erie Ave. and Sepviva St., Philadelphia
Thos. D. Shoemaker, 1241 Day St., Philadelphia.

BOXES AND CRATES, PACKING—Continued

Tait Bros., 917 E. Montgomery Ave., Philadelphia
H. Tiedemann, N. W. Cor. Nineteenth and Washington Ave., Philadelphia
Tioga Foundry Co., Twenty-second and Allegheny, Philadelphia
Treen Box Co., Tioga and Memphis Sts., Philadelphia
Emil Walther, 1106 N. Fourth St., Philadelphia
Joseph T. Ward, 5809-19 Baynton St., Philadelphia
Robert Ward, 115 Cuthbert St., Philadelphia
Weskott & Thomson, 112-114 N. Twelfth St., Philadelphia
Westmoreland Packing Case Co., 1932 E. Westmoreland St., Philadelphia
Wm. Wharton, Jr., & Co., Inc., 25th St. and Washington Ave., Philadelphia
Andrew Wilson, Wilde and Krams, Manayunk Sta., Philadelphia
The Winner Co., 2035-45 N. Seventh St., Philadelphia
Wirt & Knox Mfg. Co., 22-24 N. Fourth St., Philadelphia
Wm. Woodward, 3017 N. Lambert St., Philadelphia
John P. Little Co., Picture Rocks.
American Steel Foundries, Thirty-sixth St. and A. V. Ry., Pittsburgh
American Window Glass Co., Farmers' Bank Bldg., Pittsburgh
Anchor Box and Lumber Co., 112 Lincoln Ave., Millvale
Axthelm Mfg. Co., 242 Third Ave., Pittsburgh
Briggs Machinery Co., 238 Second Ave., Pittsburgh
A. M. Carrow Co., Penn and Third St., Pittsburgh
The Chaplin-Fulton Mfg. Co., 28-34 Penn. Ave., Pittsburgh
Conroy Prugh Co., 1430-36 Western Ave., N. S., Pittsburgh
Crescent Bottle Co., Pittsburgh
D. O. Cunningham Glass Co., Twenty-second and Jane St., S. S., Pittsburgh
Dauler, Close & Johns, 636 Smithfield St., Pittsburgh
John Dunlap Co., P. O. Box 1023, Pittsburgh
Eiler Lumber and Mill Co., S. Twenty-third St., Pittsburgh
Epping-Carpenter Co., Forty-first and A. V. Ry., Pittsburgh
Fawcus Machine Co., 2828 Smallman St., Pittsburgh
Getty Fender & Sons, 278 Woodville Ave., Pittsburgh
Bernard Gloekler Co., 1127-33 Penn Ave., Pittsburgh
Iron City Sanitary Mfg. Co., 1514 Oliver Bldg, Pittsburgh
F. J. Kress Box Co., 2920 Liberty Ave., Pittsburgh
McConway & Tooley Co., 48th St. and A. V. Ry. Co., Pittsburgh
Macbeth-Evans Glass Co., 410 Liberty Ave., Pittsburgh
The Marine Mfg. and Supply Co., Water St., Pittsburgh
The Morris and Bailey Steel Co. at Wilson, Pittsburgh
Mortimer Glass Co., 409 Lewis Bldg, Pittsburgh.
Phoenix Glass Co., P. O. Box 757, Pittsburgh
Piccardo Macaroni Co., 179-187 Forty-first St., Pittsburgh
H. K. Porter Co., 49th St. and A. V. Ry., Pittsburgh
Richardson Mfg. Co., 855-57 Progress St., Pittsburgh
F. P. Schlelein Machine Co., 32 W. Parkway, Pittsburgh
A. F. Schwerd Mfg. Co., 145 McClure Ave., N. S., Pittsburgh
Sigwart & Rolston Mch. Works, Cor. Garrison Pl. and Duquesne Way, Pittsburgh
The Simonds Mfg. Co., Twenty-fifth and Liberty Sts., Pittsburgh
Sommerfield Machine and Mfg. Co., 216 Second Ave., Pittsburgh
The Standard Scale and Supply Co., 243 Water St., Pittsburgh
U. S. Glass Co., Ninth and Bingham Sts., Pittsburgh
U. S. Sanitary Mfg. Co., Pittsburgh
Federated Glass Co., Point Marion
Jeannette Window Glass Co., Point Marion
The Morris Glass Co., Point Marion
Point Marion Window Glass Co., Point Marion
Alleghany Window Glass Co., Port Alleghany
Mississippi Glass Co., Port Alleghany
The Olean Glass Co., Port Alleghany
Ellis Keystone Agl. Works, Pottstown
Roberts, Winner & Co., Quakertown
Sieling Furniture Co., Railroad
Anchor Bending Works, Reading
Biehls' Carriage and Wagon Works, Reading
Abner S. Deysher, Reading
Leinbach Box Co., Reading.
Nolde & Hoost Co., Reading
Lesher-Kaig Knitting Co., Ltd., Reamstown
Miller Bros., Red Lion
Red Lion Furniture Co., Red Lion
Noah C. Stabley, Red Lion
Oil City Asbestos Co., Reno
Jefferson Macaroni Co., Reynoldsville
Landis Bros., Rheems
M. H. Wiest & Son, Richland
Victor Box Mfg. Co., Richland Center
B. H. Harman, Rock Glen
Emanuel G. Fry, Rothsville
Buckwalter Stove Co., Royersford
Diamond Glass Co., Royersford
Grander Stove Co., Royersford
Keystone Meter Co., Royersford
W. H. Newborn & Co., Royersford
Royersford Spring Bed Co., Royersford
Jno. F. Fitzimons, Schellburg
Meck & Keever, Schuylkill Haven
Noah Law Box Factory, Seven Valleys
Harper Bros., Shade Gap
The National Malleable Castings Co., Sharon
Nufer Cedar Co., Sharon
Sheffield Glass Bottle Co., Sheffield
Elk Flint Bottle Co., Shinglehouse
Boher & Phillips, Shippensburg
Peerless Furniture Co., Shippensburg
Shrewsbury Furniture and Mfg. Co., Shrewsbury
American Slate Works, Slatington
National School Slate Co., Slatington
Thomas Zellner, Slatington
Empire Glass Co., Smethport
Smethport Glass Co., Smethport
Bethlehem Steel Co., South Bethlehem
The Graves & Eighmy Co., Springboro
Keystone Stove Foundry, Spring City
Spring City Glass Works, Ltd., Spring City
Becker Novelty Co., Spring Creek
Milton E. Shick, Stevens
Stewartstown Furniture Co., Stewartstown
Sunbury Table Works, Sunbury
Fidelity Glass Co., Tarentum
Pittsburgh Plate Glass Co., Tarentum
Messinger Mfg. Co., Tatamy
Titusville Handle Co., Titusville
J. O. Frost's Sons, Towanda
Frank A. Rockwell, Troy
Troy Engine and Machine Co., Troy
Hanson Furniture Co., Union City
Loomis Table and Furniture Co., Union City
The Novelty Wood Works Co., Union City
The Star Handle Co., Union City
Keystone Bottle Mfg. Co., Uniontown
Verona Tool Works, Verona
Granville Hahn, Walnutport
Griffiths Charcoal Iron Mills, Washington
Highland Glass Co., Washington
Washington Tin Plate Co., Washington
Emmert Mfg. Co., Waynesboro
Frick Co., Waynesboro
Landis Machine Co., Waynesboro
Landis Tool Co., Waynesboro
Osterberg Tin Plate Co., Waynesburg
D. W. Frazee, Wellsboro
Hoopes Bro. & Darlington, Inc., West Chester
W. B. Bertels & Son Co., Wilkes-Barre
George B. Breon, Williamsport
A. H. Heilman & Co., Williamsport
National Furniture Co., Williamsport
J. K. Rishel Furniture Co., Williamsport
West Branch Box and Lbr. Co., Williamsport
Westinghouse Air Brake Co., Wilmerding
Arnold & Tschop, Windsor
Williamson & Moyer, Womelsdorf
Nufer Cedar Co., Woodlawn
Cold Springs Bleaching and Finishing Works, Yardley
H. E. Boring & Bro., York
Aden Buser, York, R. D.
A. B. Farquhar Co., Ltd., York

BOXES AND CRATES, PACKING—Continued

H. W. Heffner & Son, York
A. Kauffman & Bro., York
Keystone Farm Machine Co., York
Marion H. Long, York
The Martin Carriage Works, York
Wallick & Gohn, York
West York Furniture Mfg. Co., York
York Carriage Co., York
York Wagon Gear Co., York
Youngsville Mfg. Co., Youngsville

BOXES, CIGAR

Geo. M. Wechter, Akron
A. H. Balliet, Allentown
F. S. Koons, Boyertown
Monroe Jarrett, Cressman
Merchant Cigar Box Co., Dallastown
Pioneer Steam Cigar Box Factory, Dallastown
H. L. Heiser, Denver
John J. Hillegrass, East Greenville
C. E. Myers, East Prospect
M. Kinports, Ephrata
Smith & Spahr, Etters
Felton Cigar Box Factory, Felton
Arthur C. Brown, Freeburg
H. E. Bair & Co., Hanover
S. M. Kann, Hellam
F. A. Heim & Bros., Lancaster
Inland City Cigar Box Co., Lancaster
Geo. E. Wisner, Lancaster
Geo. R. Julius & Bros., Littlestown
Penn Box Co., Inc., McSherrystown
C. Bear, Manheim
Geo. W. Holtzman, Myerstown
New Cumberland Box Co., New Cumberland
W. K. Gresh & Sons, Norristown
E. H. Leaman, Paradise
F. Brecht's Sons, 109 N. Orianna, Philadelphia
Gegner & Klingler, 223 S. American St., Philadelphia
H. W. Jarrett & Co., 2200 Marshall St., Philadelphia
Quaker City Cigar Box Co., 220 N. 2d St., Philadelphia
Henry H. Sheip Mfg. Co., N. E. Cor. 6th St. and Columbia Ave., Philadelphia
Sheip & Vandergrift, Inc., 814-832 N. Lawrence, Philadelphia
Keystone Box Co., 19 Miller, Pittsburgh
D. J. Rex & Co., Boyd and Locust Sts., Pittsburgh
P. C. Smith & Bros., Corry and Kilbrick Sts., Pittsburgh
Joseph Wasser, No. 1 Miller St., Pittsburgh
Womer & Bock, Pottsville
W. B. Fichthorn, Reading
L. B. Miller, Red Hill
J. E. Detwiler, Red Lion
Miller Bros., Red Lion
M. H. Wiest & Son, Richland
Victor Box Mfg. Co., Richland Center
W. A. Kalbach & Sons, Robesonia
Emanuel G. Fry, Rothsville
Samuel Hauser, Schaefferstown
Monroe D. Sellers, Sellersville
Noah Law Box Factory, Seven Valleys
H. S. Souder, Souderton
Ertel Bros., Williamsport
Arnold & Tschop, Windsor
Williamson & Moyer, Womelsdorf
James R. Huthmaker, Wyoming
Aden Buser, York
H. W. Heffner & Son, York
A. Kauffman & Bros., York
E. Myers & Co., York
Wallick & Gohn, York

BRUSHES

H. Weitzer, Braman
Earle Brush Co., Columbia
C. A. Mahle & Son, Corry
August Fligge, Hecla
Holgate Bros. Co., Kane
H. A. Williams, Lake Como
Elder & Jenks, 415 Vine St., Philadelphia
Thomas J. Fleming, 131 N. Tenth St., Philadelphia
Theo. A. Gerike, 205 Quarry St., Philadelphia
The Harvey & Watt Co., 1822 E. Venango St., Philadelphia
Nelms & Co., 407 Commerce St., Philadelphia
Thomas Ott & Co., 1124-1132 Washington Ave., Philadelphia
Leon Rozzen, 1003 N. Second St., Philadelphia
A. Steiert & Son, 1406 S. Front, Philadelphia

BUTCHERS' BLOCKS AND SKEWERS

P. B. Crider & Son, Bellefonte
Reading Wood Pulley Co., Reading
Patterson Bros. Co., Wellsboro

CAR CONSTRUCTION

Adamsburg Gas Coal Co., Adamsburg
Alden Coal Co., Alden Station
W. Harry Brown, Alicia
Bellfield Coal and Coke Co., Altoona
Dunbar Coal Mining Co., Altoona
Latrobe Coal Co., Altoona
Lilly Coal Co., Altoona
Penn. R. R. Car Shops, Altoona
East Penn. Lumber Co., Inc., Analomink
Fall Brook Coal Co., Antrim
West Penn. Coal Mining Co., Apollo
Neelir Coal Co., Argentine
Central R. R. Co. of New Jersey, Wilkes-Barre, Ashley Br. P. O.
Mrs. Louise Mensch, Auburn
Pittsburgh and Southwestern Coal Co., Avella
Charles M. Dodson & Co., Beaver Brook
Beaver Run Coal Co., Beaverdale
A. Davidson, Beaver Falls
Penn. R. R. Co., Bellwood
Geo. P. Brubaker, Berlin
Connell Anthracite Mining Co., Bernice
Wachua-Taylor Anthracite Coal Co., Bernice
American Car and Foundry Co., Berwick
Lehigh and New England R. R., Bethlehem
Kettle Creek Coal Mining Co., Bitumen
Bells Mill Coal Co., Blairsville
Blairsville Coke Co., Blairsville
Conemaugh Coal Co., Blairsville
Graff Coal Co., Blairsville
Kiskiminitas Coal Co., Blairsville
Maher Coal and Coke Co., Blairsville
Roaring Run Mining Co., Blairsville
American Car and Foundry Co., Bloomsburg
Bloomsburg Car and Equip. Co., Bloomsburg
Herman & Hassert, Inc., Bloomsburg
Blossburg and Coal Run Coal Co., Blossburg
Jenkins Bros., Blossburg
Terry Coal Co., Blossburg, R. D.
Improved Traction Eng. Co., Boynton
McClane Coal Co., Bridgeville
Franklin Coal Mining Co., Brisbin
Brier Hill Coke Co., Brier Hill
Schuylkill Lehigh Coal Co., Brockton
Toby Coal Mining Co., Brockwayville
Monongahela R. R. Car Repair Shops, Brownsville
Union Connellsville Coke Co., Brownsville
Lake Shore Gas Coal Co., Buena Vista
Cascade Coal & Coke Co., Buffalo, N. Y.
Standard Steel Car Co., Butler
East Mountain Coal Co., Carbondale
Wm. M. Cole, Carnegie
P. & R. R. R. Repair Shops, Catawissa
H. K. Wick & Co., Catfish
Cumberland Valley R. R. Co., Chambersburg
Cheat Haven Coal & Coke Co., Cheat Haven
Cherry Tree Iron Works, Cherry Tree
Hastings Coal & Coke Co., Cherry Tree
H. J. Stone Coal Co., Childs
Clearfield Bituminous Coal Corp., Clearfield
Clearfield Clay Working Co., Clearfield
Goshen Coal Co., Clearfield
D. F. Gulich, Clearfield, R. D.

CAR CONSTRUCTION—Continued

Clermont Sewer Pipe Co., Clermont
Blain Run Coal Co., Coalport
Evans Coal & Coke Co., Connellsville
Francis Coal Co., Connelton
Pittsburgh Coal Co., Coraopolis
Jos. Walton, Pittsburgh, Crafton Br. P. O.
McFetridge Bros. Coal Co., Creighton
Pittsburgh Plate Glass Co., Creighton
Penna. R. R. Co., Cresson
Ford Colliers Co., Curtisville
Washington Coal & Coke Co., Dawson
Dixonville Coal Co., Dixonville
George Minus, Jr., DuBois
Reed Colliery Co., Dudley
Dunbar Furnace Co., Dunbar
H. V. Lukens, Duncannon, R. D.
Oak Hill Coal Co., Duncott
Carney & Brown Coal Co., Scranton, Dunmore Br. P. O.
Hillside Coal & Iron Co., Dunmore Br. P. O.
Keystone Mining Co., East Brady
Monarch Coal Co., East Brady
Springfield Coal Mining Co., Ebensburg
Boynton Coal Co., Elk Lick
Erie Car Works, Erie
Mizener Coal Co., Erie
Pittsburgh & Erie Coal Co., Erie
F. H. Campbell, Espyville
The Edward Dambach Co., Evans City
Jos. E. Thropp, Everett
Export Coal Co. (Hdqrs. Pittsburgh), Export
The Struthers Coal & Coke Co., Fairbank
Eagle Coal Co., Fredell
Ben Franklin Coal Co., Freeport
Kerr Coal Company, Freeport
Buffalo & Susquehanna R. R., Galeton
The Taylor & McCoy Coal & Coke Co., Gallitzin
Enterprise Coal Co., Garrett
W. A. Merrill & Co., Garrett
W. R. McTurk Coal Co., Girardville
Cornell Coal Co., Glassmere
Graceton Coke Co., Graceton
Apollo Coal Co., Greensburg
Atlantic Crushed Coke Co., Greensburg
Jamison Coal & Coke Co., Greensburg
Keystone Coal & Coke Co., Greensburg
J. C. Reed, Greensburg
Donohoe Coke Co., Greenwald
Mutual Coal Mining Co., Grove City
Standard Coal Mining Co., Grove City
Harleigh Broadwood Coal Co., Harleigh
Pond Creek Coal Co., Harleigh
Penna. R. R. Co., Harrisburg
Western Maryland Railway Co., Harrow
Red Top Coal Co., Hastings
Rich Hill Coal Co., Hastings
J. S. Wentz & Co., Hazelbrook
Evans Colliery Co., Hazleton
Harwood Coal Co., Hazleton
Hazle Mountain Coal Co., Hazleton
A. Pardee & Co., Hazleton
Estate of A. S. Van Wickle, Hazleton
Penn-Mary Coal Co., Heilwood
Hormel Coal Co., Hickman
Maple Ridge Coal Co., Holsopple
W. S. B. Hays, Homestead
Knickerbocker Smokeless Coal Co., Hooversville
Somerset Mining Co., Hooversville
Frelin Coal Co., Houtzdale
Ziegler Coal Co., Houtzdale
The Huntingdon & Broad Top M. R. R. & C. Co., Huntingdon
Huntingdon Coal Co., Huntingdon
John Langdon, Huntingdon
Irwin Foundry & Car Co., Irwin
Broad Top Coal & Mineral Co., Jacob
G. B. Markee Co., Jeddo
N. Y. C. & H. R. R. R. Co., Jersey Shore
Humbert Coal Co., Jessup
Cambria Steel Co., Johnstown
Citizens' Coal Co., Johnstown
A. J. Haws & Sons, Johnstown
The Lorain Steel Co., Johnstown
Smokeless Coal Co., Johnstown
Somerset & Cambria Coal Co., Johnstown
Suppes Coal Co., Johnstown
Great Lakes Coal Co., Kaylor
Reading Iron Co., Kimmelton
East Boston Coal Co., Kingston
The Kingston Coal Co., (Wilkes-Barre), Kingston Br. P. O.
Allegheny River Mining Co., Kittanning
Stewart Coal Co., Knox Dale
Orenstein-Arthur Koppel Co., Koppel
Clearfield & Cambria C. & C. Co., LaJose
F. A. Lane, Lanes Mills
Geo. W. Swartz, Langdondale
The Lehigh Coal & Navigation Co., Lansford
Latrobe-Connellsville Coal & Coke Co., Latrobe
Ligonier Coal Co., Latrobe
Unity Coal Co., Latrobe
Unity-Connellsville Coke Co., Latrobe
Widnoon Coal Mining Co., Lawsonham
Armstrong County Coal Co., Leechburg
West Leechburg Steel Co., Leechburg
Atlas Coke Co., Leetonia
Leetonia Lumber Co., Leetonia
Leetonia Railway Co., Leetonia
W. E. Brown & Co., Ligonier
Jas. Harris & Sons, Lilly
Leahey Coal Mining Co., Lilly
Meyersdale Coal Co., Listie
Lloydell Coal Mining Co., Lloydell
Logansport Coal Co., Logansport
Raridan & East Brady C. Co., Logansport
Northern Anthracite Coal Co., Lopez
Loyalhanna Coal & Coke Co., Loyalhanna
Brothers Valley Coal Co., Macdonaldton
Puritan Coke Co., McClellandtown
Bowman Bros. Co., McKeesport
Gatehouse & Shaft Coal Co., Madera
Thos. McGlynn, Madera
Johnetta Fdy. & Machine Co., Marianna
Pittsburgh & Butler Street Railway Co., Mars
Moosic Mountain Coal Co., Marshwood
Maryland Coal Co., Maryland
Spring Hill Coal Co., Mayfield
T. H. Wachua, Mayfield
Sharon Coal & Limestone Co., Mercer
Atlantic Coal Co., Meyersdale
Phillips Bros., Middleport
Middletown Car Co., Middletown
American Car & Foundry Co., Milton
Buck Run Coal Co., Minersville
Darkwater Coal Co., Minersville
Pine Hill Coal Co., Minersville
West End Coal Co., Mocanaqua
Wenona Coal Co., Monessen
Monongahela Saw & Plg. Mill Co., Monongahela
Dodson Coal Co., Morea Colliery
National Mining Co., Morgan
Morrisdale Coal Co., Morrisdale Mines
Penna. R. R. Co., Morrisdale
Shade Coal Mining Co., Mount Pleasant
E. J. Goodyear & Sons, Munson
Jim Ackley, New Albany
Fairmount Coal Co., New Bethlehem
The Leesburg Coal Co., New Castle
Standard Steel Car Co., New Castle
Valley Camp Coal Co., New Kensington
Fayette Coke Co., New Salem
Thompson C'ville Coke Co., New Salem, R. D.
Penna. R. R. Co., Northumberland
National Transit Co. Shops, Oil City
East Broad Top R. R. & Coal Co., Orbisonia
Ghem Coal Co., Osceola Mills
Osceola Silica & Fire Brick Co., Osceola Mills
S. B. Stine, Osceola Mills
Lehigh Valley R. R. Co., Packerton
New Jersey Zinc Co., Palmerton
The Hedstrom Coal Mining Co., Parkers Landing
Good Clay & Coal Co., Patton
Mount Jessup Coal Co., Peckville
Pencoyd Iron Works, Pencoyd
Penfield Coal & Coke Co., Penfield
Hockensmith Wheel & Mine Car Co., Penns Station
Alliance Coal Mining Co., 437 Chestnut St., Philadelphia
The Baldwin Locomotive Works, 500 N. Broad St., Philadelphia
The T. G. Brill Co., 62nd & Woodland Ave., Philadelphia
Chestnut Ridge Coal Co., West End Trust Bldg., Philadelphia
Colonial Collieries Co., North American Bldg., Philadelphia
Cymbria Coal Co., 1000 Franklin Bank Bldg., Philadelphia
Dixon Coal Co., 727 Land Title Bldg., Philadelphia
Ebensburg Coal Co., 727 Land Title Bldg., Philadelphia
Forge Coal Mining Co., 1000 Franklin Bank Bldg., Philadelphia
Glenwood Coal Co., 1000 Franklin Bank Bldg., Philadelphia
Hale & Kilburn Co., 18th St. & Lehigh Ave., Philadelphia

CAR CONSTRUCTION—Continued

Highland Coal Mining Co., Real Estate Trust Bldg., Philadelphia
Logan Coal Co., Harrison Bldg., Philadelphia
Loyalhanna Coal & Coke Co., Land Title Bldg., Philadelphia
Lehigh & Wilkes-Barre Coal Co., 716 Reading Terminal, Philadelphia
Nanty Glo Coal Mining Co., 727 Land Title Bldg., Philadelphia
Northern Central Railway, Philadelphia
Pennsylvania R. R., West Philadelphia, Philadelphia.
Philadelphia Rapid Transit Co., Land Title Bldg., Philadelphia
Phila. & West Chester Railway Co., Philadelphia
W. H. Piper & Co., Real Estate Trust Bldg., Philadelphia
Plymouth Coal Mining Co., Real Estate Trust Bldg., Philadelphia
Shoemaker Coal Mining Co., 1507 Real Estate Trust Bldg., Philadelphia
South Fork Coal Mining Co., Bullitt Bldg., 421 Chestnut St., Philadelphia
Sterling Coal Co., 421 Chestnut St., Philadelphia
Urey Ridge Coal Co., 1000 Franklin Bank Bldg., Philadelphia
Ashman Coal Co., Philipsburg
Atherton-Barnes Co., Philipsburg
Madeira-Hill Coal Mining Co., Philipsburg
R. H. Mull, Philipsburg
Victoria Coal Mining Co., Philipsburg
Wicks Bros. Coal Co., Philipsburg
Pennsylvania Railroad, Pitcairn
Aliquippa & Southern R. R. Co., Second Ave. & Ross St., Pittsburgh
Baltimore & Ohio R. R. Co., Glenwood Shops, Pittsburgh.
Bessemer Coal & Coke Co., 2212 Oliver Bldg., Pittsburgh
Bessemer Coke Co., Oliver Bldg., Pittsburgh
Blaine Coal Co., Fulton Bldg., Pittsburgh
Bolivar Coal & Coke Co., Pittsburgh
Buffalo, Rochester & Pittsburgh Ry. Co., Pittsburgh
Carnegie Coal Co., 1315 Paix Bldg., Pittsburgh
Diamond Coal & Coke Co., 1110 House Bldg., Pittsburgh
The Fayette Coal Co., Fourth Ave. & Wood St., Pittsburgh
James T. Fox, 121 Wabash St., Pittsburgh
H. C. Frick Coke Co., Pittsburgh
John M. Greek & Co., 510 Park Bldg., Pittsburgh.
Hostetter Connellsville Coke Co., Pittsburgh.
Isabella Connellsville Coke Co., Fifth Ave. & Wood St., Pittsburgh
Jenner-Quemahoning Coal Co., First Nat'l Bank Bldg., Pittsburgh
Middletown Car Co., Frick Bldg., Pittsburgh.
Montour R. R. Co., Pittsburgh
Monongahela River Cons. Coal & Coke Co., Smithfield St., Pittsburgh
Mountain Smokeless Coal Co., 2204 Oliver Bldg., Pittsburgh
Naomi Coal Co., First Nat'l Bank Bldg., Pittsburgh
Oliver & Snyder Steel Co., South Tenth & Muriel Sts., Pittsburgh
Penn. & Lake Erie R. R., Pittsburgh
Pennsylvania Railroad, 32nd & Carson Sts., Pittsburgh
Phillips Mine & Mill Supply Co., 2227 Jane St., S. S., Pittsburgh
Pittsburgh-Baltimore Coal Co., First National Bank Bldg., Pittsburgh
Pittsburgh-Buffalo Co., Fourth floor Frick Bldg., Pittsburgh
Pittsburgh Coal Co., Smithfield St., Pittsburgh
Pittsburgh-Westmoreland Coal Co., Fulton Bldg., Pittsburgh
H. K. Porter Co., 49th St. & A. V. Ry., Pittsburgh
Preston Coal Co., Fulton Bldg., Pittsburgh
Pressed Steel Car Co., Pittsburgh
J. H. Sanford Coal Co., 1315 Park Bldg., Pittsburgh
Somerset-Smokeless Coal Co., First Nat'l Bank Bldg., Pittsburgh
United Coal Co., First Nat'l Bank Bldg., Pittsburgh
United Connellsville Coke Co., Oliver Bldg., Pittsburgh
The Vesta Coal Co., Third Ave. & Ross St., Pittsburgh
Wabash Pittsburgh Ter. Ry. Co., Liberty & Ferry Sts., Pittsburgh
James Walton, Crafton (Br. P. O.), Pittsburgh
McCauley Coal Co., Pittston
Yost Mining Co., Pittston
Parrish Coal Co., Plymouth
The Penker Coal Co., Portage, R. D.
Union Railroad Co., Port Perry
Penna. R. R. Co., Pottsville
The Phila. & Reading Coal & Iron Co., Pottsville
Anita Coal Mining Co., Punxsutawney
Bowersville Coal Co., Punxsutawney
John McLeavy & Co., Punxsutawney
Punxsutawney Coal Mining Co., Punxsutawney
Punxsutawney Fdy. & Machine Co., Punxsutawney
Colonial Coal Co., Puritan
Geo. Pearce & Sons, Puritan
Bulah Shaft Coal Co., Ramey
Girard Mammoth Coal Co., Ravenrun
Philadelphia & Reading Ry. Co., Reading
Jermyn & Co., Rendham
Hugh McHugh, Rennerdale
Penna. R. R. Co., Renovo
Russell Car & Iron Plow Co., Ridgway
Brandenburg Coal Mining Co., Rockwood
Irvona Coal & Coke Co., Rose Bud
Butcher Creek Coal Co., Saint Clair
Mount Hope Coal Co., Saint Clair
Saint Clair Coal Co., Saint Clair.
Shawmut Mining Co., Saint Marys
Cochran Coal Co., Salina
Bowman Coal Mining Co., Saltsburg
M. S. Kemmerer & Co., Sandy Run
E. Eichelberger & Co., Saxton
Lehigh Valley Railroad Co., Sayre
Lincoln Coal & Coke Co., Scottdale
Bulls Head Coal Co., Scranton
Carney & Brown Coal Co., Dunmore, Scranton
Delaware, Lackawanna & Western R. R. Co., Scranton
Dolph Coal Co., Ltd., Scranton
Hillside Coal & Iron Co., Dunmore, Scranton
Lackawanna & Wyoming Valley R. R. Co., Scranton
Nay Aug Coal Co., Scranton
Pennsylvania Coal Co., Dunmore, Scranton
People's Coal Co., Scranton
Scranton Coal Co., Scranton
Traders' Coal Co., Scranton
Oxford Coal Co., Shaft
H. H. Smith Co., Shaft
Greenough Red Ash Coal Co., Shamokin
Shipman Coal Co., Shamokin
Pardoe Coal Co., Sharon
Westerman Filer Co., Sharon
Shawmut Vitrified Paving Brick Works, Shawmut
Tionesta Valley Railroad Co., Sheffield
Thomas Colliery Co., Shenandoah
James M. McIntyre, Six Mile Run
Schipper Bros Coal Mining Co., Six Mile Run
Baxter Ridge Coke Co., Smithfield
H. R. Sackett C. & C. Co., Smithfield
Smithfield Coal & Coke Co., Smithfield
Clark Bros. Coal Mining Co., Smokerun
Leland Coal Mining Co., Smokerun
W. A. Barron, Somerset, R. D.
Consolidation Coal Co., Somerset
Sonman Shaft Coal Co., Sonman
H. C. Stineman, South Fork
O. M. Stineman, South Fork
Detinger Bros., Spangler
Woodland Coal & Coke Co., Spangler
Mercer Iron & Coal Co., Stoneboro
H. K. Underwood, Strattonville
New York, Susquehanna & Western R. R. Co., Stroudsburg
Moses Neyer, Summithill
East Deer Coal Co., Tarentum
Price-Pancoast Coal Co., Throop
Susquehanna & New York R. R. Co., Towanda
Upper Lehigh Coal Co., Upper Lehigh
Browning Coke Co., Uniontown
Brownsville Coke Co., Uniontown
Hustead-Semans Coal & Coke Co., Uniontown
Magee Coke Co., Uniontown
Mount Hope Coke Co., Uniontown
Newcomer Coke Co., Uniontown
W. J. Parshall, Uniontown
Prospect C. & C. Co., Uniontown
Shannon C. & C. Co., Uniontown
South Fayette Coke Co., Uniontown
Sunshine Coal & Coke Co., Uniontown
Tower Hill Connellsville Coke Co., Uniontown

CAR CONSTRUCTION—Continued

Waltersburg Coke Co., Uniontown
Whyel Coke Co., Uniontown
Pennsylvania R. R., Verona
Vinton Colliery Co., Vintondale
Oakes Bros. Coal Co., Volant, R. D.
Genuine Connellsville Coke Co., Waltersburg
Beaver Coal & Coke Co., Wampum
Waynesburg & Washington Railroad Co., Waynesburg
Lackawanna Coal & Coke Co., Wehrum
A. J. Lundquist & Co., Wellsboro, R. D.
Midvalley Coal Co., Wilburton
Standard Moshannon Coal Co., Williamsport
Central R. R. Co. of New Jersey, Ashley, Wilkes-Barre
Lehigh Valley Coal Co. & Coxe Bros. & Co., Inc., Wilkes-Barre
Morris Run Coal Mining Co., Wilkes-Barre.
W. H. Shepherd & Son, Wilkes-Barre
Susquehanna Coal Co., Wilkes-Barre
Vulcan Iron Works, Wilkes-Barre
The Shenango Furnace Co., Wilpen
Berwind-White Coal Mining Co., Windber
Rummel Coal Mining Co., Windber
Carnwath Coal Co., Winburne
*Cascade Coal & Coke Co. (Mines at Tyler and Sykesville, Penn.), Buffalo, N. Y.
*Jefferson & Clearfield Coal & Iron Co., Rochester, N. Y.
*Rochester & Pittsburgh Coal & Iron Co., Rochester, N. Y.
*Allegheny Coal Co. (Mines at Cheswick, Penn.), Cleveland, Ohio
*Warren-Leonard Coal Co., Cleveland, Ohio.
*Warner-Youghiogheny Coal Co., Cleveland, Ohio
*The Youghiogheny & Ohio Coal Co., Cleveland, Ohio
*Island Run Coal Co., East Liverpool
*Atlas Coke Co. (Works at Helen, Penn.), Leetonia, Ohio
*McKeefrey Coal Co., Leetonia, Ohio
*LaBelle Coke Co., Steubenville, Ohio
*The Witch Hazel Coal Co., Youngstown, Ohio

CASKETS AND COFFINS

Bangor Casket Mfg. Co., Bangor
Boyertown Burial Casket Co., Boyertown
Erie Burial Case Co., Erie
F. H. Campbell, Espyville
The Freedom Casket Co., Freedom
Harrisburg Burial Case Co., Harrisburg
Hazleton Mfg. Co., Hazleton
J. S. Claypool Lbr. Co., Kittanning
J. D. Bowers, New Holland
J. C. Henninger, New Holland
Penna. Burial Case Co., Reynoldsville
Riegelsville Mfg. Co., Riegelsville
C. L. Wilmot, Rome
A. & J. Janton, 1408-10 N. Eleventh St., Philadelphia
The Paxson & Comfort Co., 529 Arch St., Philadelphia
National Casket Co., 733 Chartiers St., North Diamond Sta., Pittsburgh
C. G. Sellers, Saint Thomas
United States Casket Co., Scottdale
John Benore, Scranton
Sunbury Coffin and Casket Co., Sunbury
Sunderland Lumber Co., Sunbury
Bischoff Estate, Tamaqua
Charles Fritz, Weisenburg
L. B. Lacey, West Auburn

CHAIRS AND CHAIR STOCK

Boehm & Spiegel Co., Allentown
Johnston & Swartz, Allentown
The Yeager Furniture Co., Allentown
A. C. Kelly, Center Moreland
Clearfield Wooden-Ware Co., Inc., Clearfield
Coraopolis Mfg. Co., Coraopolis
Corry Chair Co., Corry
U. S. Chair Co., Corry
Keystone Handle Co., Corydon
J. D. Westcott & Son, Endeavor
B. T. Beers, Fallentimber
Kurtz Furniture Co., Fullerton
Greensburg Swing Co., Greensburg
American Chair Manufacturing Co., Hallstead
Wm. Kemper, Hampton
Jesse Wolford, Hunterstown
Indiana Bent Rung Ladder Co., Indiana
W. DeFrehn & Sons, Johnstown
Emporium Lumber Co., Keating Summit
Salmon Creek Lumber Co., Kellettville
Penn. Swing & Ladder Co., Lancaster
Lewisburg Chair Co., Lewisburg
Lehentaler Bros., Loleta
Glen Mawr Novelty Works, Mawrglen
Willson-Bennett-Porter Co., Montoursville
James Barker, Inc., Sixth & Cayuga, Philadelphia
Bloch Go-Cart Co., 1136-48 N. American St., Philadelphia
Bodenstein & Kuemmerle, Inc., Lawrence St. & Girard Ave., Philadelphia
James W. Cooper Co., 1706-20 Washington Ave., Philadelphia
John Grass Wood Turning Co., 222 Vine St., Philadelphia
J. Hetherington, 206 Quarry St., Philadelphia
Sikes Furniture Co., 23rd & Passyunk, Philadelphia
I. H. Wisler & Son, 223 & 225 N. Sixth St., Philadelphia
A. G. Pera, 5958 Baum St., Pittsburgh
Pittsburgh Hardwood Working Co., 34 Water St., Pittsburgh
M. M. Whetstone, Schellsburg
Mayes Novelty Factory, Sonestown
The Tidioute Rocker Co., Ltd., Tidioute
Titusville Elastic Chair Co., Titusville
Titusville Handle Co., Titusville
The Shreve Chair Co., Union City
Standard Chair Co., Union City
The Union City Chair Co., Union City
Variety Turning & Furn. Mfg. Co., Union City
Samuel Peterson, Warren
F. B. Sherman, Williamsburg
J. K. Rishel Furniture Co., Williamsport
Simmons Wood Working Co., Williamsport
D. N. Byers, Woodbury

CLOCKS

Then Pen Argyl Clock Case Co., Pen Argyl
American Cuckoo Clock Co., 1665 Ruffner St., Philadelphia
Fred Frick Clock Co., Waynesboro

DAIRYMEN'S, POULTERERS' AND APIARISTS' SUPPLIES

Charles Incubator Co., Columbia
F. E. Westby, Corry
Prairie State Incubator Co., Homer City
W. S. Wilcox, Turnersville, Jamestown P. O.
Dairymen's Supply Co., Lansdowne
W. R. Wilcox, Lawrenceville
Roller Tray Incubator Co., Northampton
Phoenixville Mch. Co., Phoenixville
The Sharples Separator Co., West Chester
H. W. White, Whites Valley

ELEVATORS

Sprout, Waldron & Co., Muncy
The Albro-Clem Elevator Co., Seventh St. & Glenwood Ave., Philadelphia
Atlas Elevator Co., 611 Cherry St., Philadelphia
Eastern Elevator Co., 228 Callowhill, Philadelphia
Energy Elevator Co., 218 New St., Philadelphia
Walter E. Goodman, 922 Callowhill, Philadelphia
Independence Elevator Co., 710 Cherry, Philadelphia
Keystone Elevator Co., 23rd & Sansom Sts., Philadelphia

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*These companies have collieries in Pennsylvania.

ELEVATORS—Continued

Oneida Elevator Co., 733 Cherry St., Philadelphia
O'Neill Elevator Co., 628 Cherry St., Philadelphia
Otis Elevator Co., 1105 Frankford Ave., Philadelphia
Supplee Elevator Co., 3207 Spring Garden, Philadelphia
Marshall Bros. 21st & Mary Sts., S. S., Pittsburgh
John G. Speidel, Reading

EQUIPMENT, PLAYGROUND

Noll Bros. & Smith, Bausman
Bullock Swing & Chair Mfg. Co., Inc., Bellefonte
Hertzler & Zook Co., Belleville
Clearfield Novelty Works, Clearfield
Clearfield Woodenware Co., Inc., Clearfield
Coraopolis Mfg. Co., Coraopolis
Standard Novelty Works, Duncannon
East Greenville Mfg. Co., East Greenville
A. Buch's Sons Co., Elizabethtown
Greensburg Swing Co., Greensburg
McKay Gilmore Furniture Co., Grove City
Penn Swing & Ladder Co., Lancaster
Glen Mawr Novelty Works, Mawrglen
Eclipse Pulley Co., Meyersdale
Penn Wheelbarrow Co., 4741 Kansas St., Pittsburgh
R. M. Bowser & Son, Renfrew
The Specialty Mfg. Co., Titusville
J. C. McQuaid, West View
Keystone Farm Machine Co., York

EXCELSIOR

J. K. Hornbeck, Equinunk
Hotchkiss & Son, Lawrenceville
Gormley Brothers, Hoadleys
Handle & Excelsior Co., Picture Rocks
Prompton Excelsior Co., Prompton
M. Elmore, White Mills

FIXTURES

Anton Loeper, Ashland
Adam Waldner, Ashland
Penn. R. R. Car Shops, Altoona
Kurtz Bros., Bethlehem
Hoover Bros. Mfg. Co., Berrysburg
A. B. Hartman, Bloomsburg
Federal Equipment Co., Carlisle
Walton Lumber Co., Charleroi
St. Francis Industrial School, Eddington
Exhibition Show Case Co., Erie
Johannesen Mfg. Co., Erie
M. Schultz, Gallitzin
Glen Mfg. Co., Glen Rock
L. B. Walbert, Hancock
Henry Shaffer Lumber Co., Kittanning
The Wohlsen Planing Mill Co., Lancaster
H. E. Walters, Middleburg
Middletown Furniture Co., Middletown
Montgomery Table Works, Montgomery
Stokes Mfg. Co., Montgomery
Basch & Co., 402 Cherry, Philadelphia
B. Bernheim & Sons, 1401 N. Third St., Philadelphia
Meyer Cossoy, 624 Filbert St., Philadelphia
John Ernst & Co., 2208 Germantown Ave., Philadelphia
J. Fisher & Co., 1216-18 N. Fifth St., Philadelphia
Chas. C. Geissler, 62 N. Fourth St., Philadelphia
Interior Milling Co., 2531 Poplar St., Philadelphia
Irons Co., 1401 Germantown Ave., Philadelphia
Karcher & Rehn Co., Twelfth & Hamilton Sts., Philadelphia
Kasansky & Bloom, 231-33 N. Lawrence St., Philadelphia
Stephen F. Ketran, 12 S. 24th St., Philadelphia
Keystone Display Rack Co., 1132 Parrish, Philadelphia
J. Kirchhof & Co., 448 N. Twelfth St., Philadelphia
Francis D. Kramer, 1601 Spring Garden St., Philadelphia
A. H. & F. H. Lippincott, Inc., 24th & Locust Sts., Philadelphia
George E. Lucas, 2013 Montgomery Ave., Philadelphia
John J. McCloskey, 149 N. Fourth St., Philadelphia
Mallock & Coddington, 611 Cherry St., Philadelphia
Miller & England Co., 1124-32 Washington Ave., Philadelphia
Northern Central Railway (Address, Mt. Vernon Car Shop, Baltimore, Md.), Philadelphia
Pennsylvania Store Fixture Co., 1304 N. Second St., Philadelphia
Julius A. Raith's Sons, 304 Master St., Philadelphia
Ridgway Refrig. Co., 3519 N. Lawrence St., Philadelphia
William Russell Woodworking Co., 3015-29 Chestnut St., Philadelphia
Harry R. Rust, 724-26 Ludlow St., Philadelphia
Sanitary Specialties Co., 1824 E. Clearfield St., Philadelphia
C. J. & A. Schad, 519 Bainbridge St., Philadelphia
Segall & Son, 720 Jefferson St., Philadelphia
Louis Sher, 2132 S. Eighth St., Philadelphia
Silberman & Fleisher, 1218 Mascher, Philadelphia
John E. Sjostrom Co., Inc., 1719 N. Tenth St., Philadelphia
Smedley Bros. Co., Church & Tacony Sts., Philadelphia
H. Dan'l Sorg, S. W. cor. Front & Montgomery Aves., Philadelphia
Robert Tarlo & Son, 413-17 S. Fifth St., Philadelphia
H. Tiedemann, N. W. cor. Nineteenth St. & Washington Ave., Philadelphia
V. W. Mfg. Co. (John B. Vernon, Partner), 1616 North St., Philadelphia
Harry Walter, 1711 N. 31st St., Philadelphia
Weisner, Weis & Co., 240 Cherry St., Philadelphia
A. Wilt & Sons, 721 N. Front St., Philadelphia
Frederick V. Yeager, 9-13 S. 36th St., Philadelphia
P. R. R. Co., Pitcairn
Barnes Safe & Lock Co., 327 Third Ave., Pittsburgh
S. Delp's Sons, Fourth & Liberty, Pittsburgh
Bernard Gloekler Co., 1127 Pennsylvania Ave., Pittsburgh
Kates & Co., Grant Block, Pittsburgh
Kund & Eiber Mfg. Co., 204-24 Warrington Ave., Pittsburgh
Geo. B. Monks Co., 8-10 Ketchum, Pittsburgh
National Electric Shoe Shining Mch. Co., 422 First St., Pittsburgh
Pittsburgh Hardwood Working Co., 33-34 Water St., Pittsburgh
P. & L. E. R. R., Pittsburgh
Union R. R. Co., Port Perry
Josiah Frederick, Pottstown
Penna. R. R. Co., Pottsville
R. M. Bowser & Son, Renfrew
The Woodwork Supply Co., Reynoldsville
John Benore, Scranton
Brown Bros., Scranton
Peck Lbr. Mfg. Co., Scranton
Valverde Mfg. Co., Scranton
J. R. Newbold & Co., Sellersville
The National Malleable Castings Co., Sharon
Bethlehem Steel Co., South Bethlehem
Bischoff Estate, Tamaqua
Penna. R. R., Verona
Meas Furniture Co., Warren
Warren Veneer & Panel Co., Warren
E. T. Long & Co., Wilkes-Barre
F. B. Sherman, Williamsburg
Dittmar Furniture Co., Williamsport
Geo. W. Gilbert, York
George A. Swartz, York
Youngsville Mfg. Co., Youngsville

FRAMES AND MOLDING, PICTURE

Wyman Kimble Planing Mill, Honesdale
William G. Hermann, 1111 Ridge Ave., Philadelphia
Kirkpatrick Mfg. Co., Third St. & Glenwood Ave., Philadelphia
J. E. McClees & Co., 1507 Walnut, Philadelphia
Conroy Prugh Co., 1430-36 Western Ave., N. S., Pittsburgh
American Slate Works, Slatington
National School Slate Co., Slatington
L. M. Castner, Williamsport

FURNITURE

Keystone Mfg. Co., Albion
G. H. Bear Furniture Co., Allentown
Gottlieb Buehler & Co., Allentown
C. A. Dorney Furn. Co., Allentown
Johnston & Swartz, Allentown
E. J. Schneck & Sons, Allentown
The Yeager Furniture Co., Allentown
Penna. R. R. Car Shops, Altoona
M. Poet & Son, Altoona
John E. Caruso, Ardmore
Athens Furniture Co., Athens
Hoover Bros. Mfg. Co., Berrysburg
A. B. Hartman, Bloomsburg
Hawley-Slate Furn. Co., Bloomsburg
A. D. Deemer Furniture Co., Brookville
H. Crawford & Sons, Canton
Minnequa Furn. Co., Canton
H. J. & W. A. Krumenacker, Carrolltown
P. Nicklas' Sons, Chambersburg
Henry Sierer & Co., Chambersbrug
E. M. Smith, Chambersburg
Keystone Cabinet Co., Chester
The New Farson Mfg. Co., Chester
Penn Furniture Co., Conneautville
Coraopolis Mfg. Co., Coraopolis
K-P-L. Furniture Mfg. Co., Corry
J. F. Else, Cowan
Dallastown Furniture Co., Dallastown
R. M. Prowles, Dry Run
East Greenville Mfg. Co., East Greenville
Rutter Bros., Turtle Creek, East Pittsburgh
Brown Furniture Co., East Stroudsburg
B. F. Beers, Fallentimber
Kurtz Furniture Co., Fullerton
Garland Furniture Co., Garland
Reaser Furniture Co., Gettysburg
Dise Furniture Co., Glen Rock
Enterprise Furniture Co., Glen Rock
Hess Brothers, Grantville
J. C. Reed, Greensburg
Daniel A. Burkey & Sons, Hamburg
Hanover Cabinet Co., Hanover
Long Furniture, Hanover
Penna. R. R. Co., Harrisburg
S. A. Huntsinger, Hegins
Penwarden Mfg. Co., Honesdale
Hughesville Furniture Co., Hughesville
Indiana Bent Rung Ladder Co., Indiana
Henry Shaffer Lumber Co., Kittanning
Lebanon Valley Furniture Co., Lebanon
Lehighton Lumber Co., Lehighton
LeRaysville Furniture & Toy Mfg. Co., LeRaysville
Lowry & Akeman, Ligonier
C. F. Bucher, Littlestown
Clinton Furniture Co., Lock Haven
Wm. S. Clevenger, McConnellsburg
M. T. Wertz, Malta
Mansfield Novelty Works, Mansfield
Chas. Neast & Co., Mauch Chunk
Mill Run Lumber Co., Meadville
West Branch Novelty Co., Milton
Isaac C. Decker, Montgomery
Montgomery Lounge Co., Montgomery
Montgomery Table Works, Montgomery
Montgomery Mfg. Co., Montgomery
Stokes Mfg. Co., Montgomery
Berry Bros., Montoursville
Crandall-Bennett-Porter Co., Montoursville
Woolever Bros., Montoursville
Mount Wolf Furniture Co., Mount Wolf
Muncy Mfg. Co., Ltd., Muncy
J. D. Bowers, New Holland
J. C. Henninges, New Holland
Lillo Bros. Co., Oakdale
J. G. Moyer & Sons Co., Perkasie
American Cabinet Works, 227 Buttonwood St., Philadelphia
James Barker, Inc., Sixth & Cayuga, Philadelphia
Jacob Behrend, 124 W. Allen St., Philadelphia
George W. Brenn, 1306-08 N. Marshall, Philadelphia
Burt Brothers, 2000 S. Ninth St., Philadelphia
James W. Cooper Co., 1706-20 Washington Ave., Philadelphia
Henry Dilg, 828 Wood St., Philadelphia
John A. Dabs, 269 S. Fifth St., Philadelphia
Ebert Furniture Co., Sixth & Moore Sts., Philadelphia
Christian Gebert, 141 E. Cumberland St., Philadelphia
John Grass Wood Turning Co., 222 Vine St., Philadelphia
Hale & Kilburn Co., 18th & Lehigh Ave., Philadelphia
J. S. Hardig & Son, 5109 Germantown Ave., Germantown, Philadelphia
Hoehling Bros., 314 S. Lawrence, Philadelphia
G. Horn & Co., 422 N. Orianna St., Philadelphia
Walter E. Hunt, 1615 Chestnut St., Philadelphia
Peter Josten, 1014 N. Third Ave., Philadelphia
Kasansky & Bloom, 231-233 Lawrence St., Philadelphia
Kaufmann Mfg. Co., 710-12 N. Percy St., Philadelphia
Ferdinand Keller, 216-24 S. Ninth St., Philadelphia
John Knoell & Sons, 171 Jefferson St., Philadelphia
Henry Krann Furniture Co., Sixth & Master Sts., Philadelphia
Lincoln Furniture Co., 415 Brown St., Philadelphia
McCracken & Hall, 1120 Washington Ave., Philadelphia
Thos. Mills & Bro., Inc., 1301 N. Eighth St., Philadelphia
Peter C. Osada & Co., 1422 S. Front St., Philadelphia
Page & Rainey, 230 S. Second St., Philadelphia
Morris Platt & Co., 1406 S. Front St., Philadelphia
Pooley Furniture Co., Indiana Ave., 16th & 17th Sts., Philadelphia
John H. Ragatz & Son, 212 Chancellor St., Philadelphia
Henry H. Sheip Mfg. Co., N. E. Cor. Sixth St. & Columbia Ave., Philadelphia
A. Wagenbaur, 534 N. Second St., Philadelphia
The Winner Co., 2035-45 N. Seventh St., Philadelphia
Burrows Bros. & Co., Ltd., Picture Rocks
John P. Little Co., Picture Rocks
Colonial Art Furniture Co., 3906 Fifth Ave., Pittsburgh
Dauler, Close & Johns, 636 Smithfield St., Pittsburgh
D. DeSimone, 230 Lorimer Ave., Pittsburgh
Julius Eisenberger, 560 Homewood Ave., Pittsburgh
Eastend Art Furniture Co., 4524 Forbes St., Pittsburgh
A. G. Pera, 5958 Baum St., Pittsburgh
Pittsburgh Hardwood Working Co., 33-34 Water St., Pittsburgh
H. N. Twitmyer, Pleasant Gap
Sieling Furniture Co., Railroad
Philadelphia & Reading R. R. Co., Reading
Red Lion Furniture Co., Red Lion
Noah C. Stabley, Red Lion.
C. G. Sellers, Saint Thomas
M. M. Whetstone, Schellsburg
Charles S. Metzgar, Sciota
Robinson Bros., Sharpsville
Boher & Phillips, Shippensburg
Peerless Furniture Co., Shippensburg
Shippensburg Table & Mfg. Co., Shippensburg
Shrewsbury Furniture & Mfg. Co., Shrewsbury
Pennsylvania State College, State College
Stewartstown Furniture Co., Stewartstown
Tillman Hontz, Summithill
Sunbury Table Works, Sunbury
Tidioute Furniture Mfg. Co., Tidioute
J. O. Frost's Sons, Towanda
Benj. Danahower, Trexler
W. F. Dildine, Turbotville
Rutter Bros., East Pittsburgh, Turtle Creek Br. P. O.
Loomis Table & Furniture Co., Union City
The Novelty Wood Works Co., Union City
Variety Turning & Furniture Mfg. Co., Union City

FURNITURE—Continued

Elmer Yingling, Waynesboro
Conewango Furniture Co., Warren
Geo. L. Folkman, Warren
Meas Furniture Co., Warren
Phenix Furniture Co., Warren
Warren Table Works, Warren
Watsontown Table & Furniture Co., Watsontown
Eureka Mfg. Co., Weissport
F. B. Sherman, Williamsburg
A. H. Heilman & Co., Williamsport
Keystone Furniture Co., Williamsport
National Furniture Co., Williamsport
J. K. Rishel Furniture Co., Williamsport
Williamsport Furniture Co., Williamsport
D. N. Byers, Woodbury
H. E. Boring & Bro., York.
Home Furniture, York
Keystone Farm Machine Co., York
Pa. Furniture Co., York
West York Furniture Mfg. Co., York
Forest Furniture Mfg. Co., Youngsville
Youngsville Mfg. Co., Youngsville

GATES AND FENCING

Chester Fence Co., Chester Heights
Rutter Bros., Turtle Creek, East Pittsburgh
Evan Moore, Elwyn
Henry Shaffer Lumber Co., Kittanning
Northern Central Railway (Address, Mt. Vernon Car Shop, Baltimore, Md.), Philadelphia
East End Planing Mill Co., Sexton
Rutter Bros., East Pittsburgh, Turtle Creek Br. P. O.
Geo. W. Gilbert, York

HANDLES

Penna. R. R. Car Shops, Altoona
J. L. McLaughlin & Sons, Bedford
Hertzler & Zook Co., Belleville
Cumberland Valley R. R. Co., Chambersburg
M. B. Landis & Co., Coopersburg
Codorus Handle Co., Codorus
Keystone Handle Co., Corydon
E. H. Leathers, Curtin
Ringer & Co., Delmont
C. Prouty & Co., Eldred
J. H. Young Lumber Co., Emlenton
J. D. Westcott & Son, Endeavor
Theo. J. Ely Mfg. Co., Erie
Erie City Mfg. Co., Erie
Washburn Mfg. Co., Erie
F. H. Campbell, Espyville
Penna. Saw Co., Frackville
Marsteller Bros. Lumber Co., Fredonia
Girard Wrench Mfg. Co., Girard
M. D. Hoke, Hokes Mills
Howard Handle & Spoke Co., Howard
The L. C. Hasinger Co., Indiana
Robinson & Stryke, Keating Summit
Sheldon Handle Co., Kinzua
Lehentaler Bros., Loleta
American Fork and Hoe Co., North Girard
Penn Mfg. Co., North Girard
Hammond & Son, Ogontz
J. G. Moyer & Sons Co., Perkasie
The John Buckley Hub, Spoke & Wheel Co., 969-975 N. Second St., Philadelphia
Chas. P. Foulkrod, 2235 Wood St., Philadelphia
Germantown Tool Works, 518 Commerce St., Philadelphia
John Grass Wood Turning Co., 222 Vine St., Philadelphia
Nelms Co., 407 Commerce St., Philadelphia
N. C. Railway (Address, Mt. Vernon Car Shop, Baltimore, Md.), Philadelphia
Thomas Ott & Co., 1124-1132 Washington Ave., Philadelphia
Leon Rozzen, 1003 N. Second St., Philadelphia
Handle & Excelsior Co., Picture Rocks
The J. C. Russell Shovel Co., 336 Fourth Ave., Pittsburgh
F. F. Childs, Pittsfield
Colebrookdale Iron Co., Pottstown
Reading Wood Pulley Co., Reading
Wm. Rose & Bros., Sharon Hill
Bethlehem Steel Co., South Bethlehem
Geo. H. Lancaster, South Sterling
L. Hammond, Spangler
Titusville Handle Co., Titusville
Fred Caflisch, Union City
The Star Handle Co., Union City
Union Furnace Handle Co., Union Furnace
Samuel Peterson, Warren
Chas. Fritz, Weisenburg
F. B. Sherman, Williamsburg

INSTRUMENTS, MUSICAL

A. B. Feljemaker Organ Co., Erie
A. Gottfried & Co., Erie
Kellmer Piano Co., Hazleton
Miller Organ & Piano Co., Lebanon
Bates & Culley, 706-18 Mercy St., Philadelphia
Cunningham Piano Co., 4948 Parkside Ave., Philadelphia
C. S. Haskell, 1520-22 Kater St., Philadelphia
Kinetic Engineering Co., 60th & Baltimore Ave., Philadelphia
The Lester Piano Co., 1306 Chestnut, Philadelphia
Painter & Ewing, 1105 Spring Garden, Philadelphia
Chas. F. Durner, Quakertown
Weaver Organ & Piano Co., York

INSTRUMENTS, PROFESSIONAL AND SCIENTIFIC

Penna. R. R. Co. (Foundries), Altoona
Logan Iron & Steel Co., Burnham
Theo. Alteneder & Sons, 945 Ridge Ave., Philadelphia
Charles A. Anderson, 1629 N. Tenth St., Philadelphia
Nathan Cohen, 1126 N. Orianna, Philadelphia
John Grass Wood Turning Co., 222 Vine St., Philadelphia
T. H. Grigg, Lancaster Ave. & Baring St., Philadelphia
Joseph B. Levy, 1429 21st St., Philadelphia
Lippincott Pencil Co., 220 N. 23rd St., Philadelphia
Thos. Mills & Bro., Inc., 1301 N. Eighth St., Philadelphia
Smedley Bros. Co., Church & Tacony Sts., Frankford, Philadelphia
Martin H. Walrath, Broad & Cambria Sts., Philadelphia
Bethlehem Steel Co., South Bethlehem
Verona Tool Works, Verona

INSULATOR PINS AND BRACKETS

The L. C. Hasinger Co., Indiana
Robinia Pin Co., Newville
S. J. Bailey, Nicholson
J. W. Endsley, Somerfield

LADDERS

Appolo Step Ladder Co., Appollo
Coraopolis Mfg. Co., Coraopolis
American Mfg. & Novelty Co., Erie
Indiana Bent Rung Ladder Co., Indiana
Penna. Swing and Ladder Co., Lancaster
Pencoyd Iron Works, Pencoyd
Nathan Cohen 1126 N. Orianna, Philadelphia
John P. Little Co., Picture Rocks
Acme Mfg. Co., Marshall Ave., N. S., Pittsburgh
Bethlehem Steel Co., South Bethlehem

LAUNDRY APPLIANCES

Keystone Mfg. Co., Albion
Apollo Step Ladder Co., Apollo
Clearfield Wooden-Ware Co., Inc., Clearfield
Coudersport Mangle Roller Mfg. Co., Coudersport
East Greenville Mfg. Co., East Greenville
American Mfg. and Novelty Co., Erie
Lovell Mfg. Co., Erie
The Wagner Curtain Stretcher Co., Greensburg
Wyman Kimble Planing Mill, Honesdale
S. H. Everett, McEwensville
Motz Lumber Co., Monessen
Stokes Mfg. Co., Montgomery
Miller Mfg. Co., Myerstown
The Eclipse Co., North Girard
The Empire Co., North Girard
Gen. Mfg. Co., North Girard
Frank Hopkins, North Girard
L. Hopkins Mfg. Co., North Girard
Penn. Mfg. Co., North Girard
J. T. Hammond & Son, Inc., 4534 Hedge St., Frankford, Philadelphia
John P. Little Co., Picture Rocks
Acme Mfg. Co., Marshall Ave., N. S., Pittsburgh
Josiah Frederick, Pottstown
Household Mfg. Co., Royersford
Mayes Novelty Factory, Sonestown
Sonestown Mfg. Co., Sonestown
The Specialty Mfg. Co., Titusville
D. W. Frazee, Wellsboro
Atlas Wooden Novelty Co., Williamsport
Sonestown Manufacturing Co., Williamsport

MACHINERY AND APPARATUS, ELECTRICAL

Penna. R. R. Co. (Foundries), Altoona
Westinghouse Elec. Mfg. Co., East Pittsburgh
Chas. P. Foulkrod, 2235 Wood St., Philadelphia
Louis Kirchgraber, 613-15 Cherry St., Philadelphia
Standard Underground Cable Co., Westinghouse Bldg., Pittsburgh
The Union Switch and Signal Co., Swissvale, Pittsburgh
Hazard Manufacturing Co., Wilkes-Barre

MACHINE CONSTRUCTION

S. Flory Mfg. Co., Bangor
Keystone Driller Co., Beaver Falls
Blaisdell Machinery Co., Bradford
Boviard & Seyfang Mfg. Co., Bradford
Carbondale Mch. Co., Carbondale
The Wolf Co., Chambersburg
P. G. Frederick & Co., Chicora
Wangaman Mfg. Co., Clarendon
Clearfield Machine Shops, Clearfield
Downingtown Mfg. Co., Downingtown
The Eddystone Mfg. Co., Eddystone
Wilmot Engineering Co., Hazleton
McLanahan-Stone Machine Co., Hollidaysburg
American Road Machine Co., Kennett Square
Edwards Mfg. Co., Laceyville
Curtis E. Showalter, Landisburg
Robinson Mfg. Co., Muncy
Sprout, Waldron & Co., Muncy
New Holland Machine Co., New Holland
Weaver & Co., New Oxford
Oil Well Supply Co., Oil City
New Jersey Zinc Co., Palmerton
James Barker, Inc., Sixth and Cayuga, Philadelphia
Ajax Mfg. Co., 848 Jarville, N. S., Pittsburgh
Thomas Carlins Sons Co., 1600 River Ave., Pittsburgh
Mackintosh, Hemphill & Co., Twelfth and Etna, Pittsburgh
Sigwart & Rolston Mch. Works, Cor. Garrison Place and Duquesne Way, Pittsburgh
Ellis Keystone Agl. Works, Pottstown
Philadelphia & Reading R. R. Co., Reading
Landis Bros., Rheems
Mayes Novelty Factory, Sonestown
H. C. Mapes, Tionesta
Frick Co., Waynesboro
Geiser Mfg. Co., Waynesboro
A. B. Farquhar Co., Ltd., York
Hench & Drumgold, York

MANUAL TRAINING PRACTICE (SLOYD)

School, Altoona
School, Beaver Falls
School, Braddock
School, Butler
School, Conshohocken
School, Corry
School, DuBois
School, Erie
Technical High School, Harrisburg
Schwab Industrial School, Homestead
School, Johnstown
School, Lebanon
School, Monessen
School, New Castle
Carnegie Tech. School, Pittsburgh
Schools, Pittsburgh
School, Reading
Technical High School, Adams Ave., Scranton
School, Sharon
Penn. State College, State College
Radnor Township High School, Wayne
Schools, Williamsport

MINE EQUIPMENT

Alden Coal Co., Alden Station
W. Harry Brown, Alicia
Latrobe Coal Co., Altoona
Fall Brook Coal Co., Antrim
Lake Ariel Lumber Co., Ariel
Pittsburg & Southwestern Coal Co., Avella
Charles M. Dodson & Co., Beaver Brook
Beaver Run Coal Co., Beaverdale
Connell Anthracite Mining Co., Bernice
Big Run Mfg. Co., Big Run
Bells Mill Coal Co., Blairsville
Blairsville Coke Co., Blairsvile
Conemaugh Coal Co., Blairsville
Graff Coal Co., Blairsville
Maher Coal & Coke Co., Blairsville
Roaring Run Mining Co., Blairsville
Blossburg & Coal Run Coal Co,. Blossburg
Jenkins Bros., Blossburg
Terry Coal Co., Blossburg R. D.
McClane Coal Co., Bridgeville
Brier Hill Coke Co., Bridgeville
E. J. Walker & Co., Brisbin
Schuylkill Lehigh Coal Co., Brockton
McKnight Coal Co., Brockwayville
Champion Connellsville Coke Co., Brownsville
Union Connellsville Coke Co., Brownsville
Lake Shore Gas Coal Co., Buena Vista
East Mountain Coal Co., Carbondale
Casey Coal Co., Carnegie
Cheat Haven Coal & Coke Co., Cheat Haven
Clearfield Bituminous Coal Corp., Clearfield
Clearfield Clay Working Co., Clearfield
Goshen Coal Co., Clearfield
Blain Run Coal Co., Coalport
Evans Coal & Coke Co., Connellsville
R. Manetta Coal Co., Connellsville
Manetta Connellsville Coke Co., Connellsville
Pittsburg Plate Glass Co., Creighton
E. H. Leathers, Curtin
Ford Collieries Co., Curtisville
Washington Coal & Coke Co., Dawson
George Minns, Jr., DuBois
Oak Hill Coal Co., Duncott
Carney & Brown Coal Co., Scranton, Dunmore Br. P. O.
Hillside Coal & Iron Co., Scranton, Dunmore Br. P. O.
Keystone Mining Co., East Brady
Monarch Coal Co., East Brady
Island Run Coal Co., East Liverpool
Springfield Coal Mining Co., Ebensburg
Ellsworth Collieries Co., Ellsworth
Crescent Coal Co., Epton

MINE EQUIPMENT—Continued

Export Coal Co., Export
Clinton Falls Coal Co., Forest City
Eagle Coal Co., Fredell
Kerr Coal Co., Freeport
H. D. Bradly, Gallitzin
The Taylor & McCoy Coal & Coke Co., Gallitzin
Enterprise Coal Co., Garrett
W. R. McTurk Coal Co., Girardsville
Cornell Coal Co., Glassmere
Graceton Coke Co., Graceton
Apollo Coal Co., Greensburg
Atlantic Crushed Coke Co., Greensburg
Keystone Coal & Coke Co., Greensburg
Rich Hill Coal Co., Hastings
J. S. Wentz & Co., Hazelbrook
Harwood Coal Co., Hazleton
Hazle Mountain Coal Co., Hazleton
A. Pardee & Co., Hazleton
Estate of A. S. Van Wickle, Hazleton
Penn-Mary Coal Co., Heilwood
McLanahan-Stone Mach. Co., Hollidaysburg
Penna. Smokeless Coal Co., Hollsopple
W. S. B. Hays, Homestead
Huntingdon Coal Co., Huntingdon
John Langdon, Huntingdon
The L. C. Hasinger Co., Indiana
Broad Top Coal & Mineral Co., Jacob
G. B. Markee Co., Jeddo
Humbert Coal Co., Jessup
Cambria Steel Co., Johnstown
Suppes Coal Co., Johnstown
Great Lakes Coal Co., Kaylor
East Boston Coal Co., Kingston
Allegheny River Mining Co., Kittanning
Stewart Coal Co., Knox Dale
The Lehigh Coal & Navigation Co., Lansford
Latrobe-Connellsville Coal & Coke Co., Latrobe
Unity-Connellsville Coke Co., Latrobe
Widnoon Coal Mining Co., Lawsonham
Armstrong County Coal Co., Leechburg
Jas. Harris & Sons, Lilly
Lloydell Coal Mining Co., Lloydell
Logansport Coal Co., Logansport
Raridan & East Brady C. Co., Logansport
Northern Anthracite Coal Co., Lopez
Puritan Coke Co., McClellandtown
Bowman Bros. Co., McKeesport
Moosic Mountain Coal Co., Marshwood
Spring Hill Coal Co., Mayfield
T. H. Wachua, Mayfield
Atlantic Coal Co., Meyersdale
Phillips Bros., Middleport
Buck Run Coal Co., Minersville
Darkwater Coal Co., Minersville
Pine Hill Coal Co., Minersville
West End Coal Co., Mocanaqua
Dodson Coal Co., Morea Colliery
National Mining Co., Morgan
The Leesburg Coal Co., New Castle
Thompson Connellsville Coke Co., New Salem, R. D.
Olyphant Coal Co., Olyphant, R. D.
The Hedstrom Coal Mining Co., Parkers Landing
Mt. Jessup Coal Co., Peckville
Penfield Coal & Coke Co., Penfield
Colonial Collieries Co., Philadelphia
Forge Coal Mining Co., 1000 Franklin Bank Bldg., Philadelphia
Highland Coal Mining Co., Real Estate Trust Bldg., Philadelphia
Lehigh & Wilkes-Barre Coal Co., 716 Reading Terminal, Philadelphia
W. H. Piper & Co., Real Est. Trust Bldg., Philadelphia
Shoemaker Coal Mining Co., 1507 Real Estate Trust Bldg., Philadelphia
South Fork Coal Mining Co., Bullitt Bldg., 421 Chestnut St., Philadelphia
Bessemer Coke Co., Oliver Bldg., Pittsburgh
Blaine Coal Co., Fulton Bldg., Pittsburgh
Carnegie Coal Co., 1315 Paix Bldg., Pittsburgh
H. C. Frick Coke Co., Pittsburgh
John M. Greek & Co., 310 Park Bldg., Pittsburgh
Hostetter Connellsville Coke Co., Pittsburgh
Monongahela River Consolidated Coal & Coke Co., Smithfield St., Pittsburgh
Mountain Smokeless Coal Co., 2204 Oliver Bldg., Pittsburgh
Oliver & Snyder Steel Co., South Tenth & Muriel Sts., Pittsburgh
Pittsburgh-Baltimore Coal Co., First National Bank Bldg., Pittsburgh
Pittsburgh Coal Co., Smithfield St., Pittsburgh
Pittsburgh-Westmoreland Coal Co., Fulton Bldg., Pittsburgh
Sampson & Hormel, Wilkinsburg, R. D., Pittsburgh
J. H. Sanford Coal Co., 1315 Park Bldg., Pittsburgh
Somerset Smokeless Coal Co., First National Bank Bldg., Pittsburgh
United Coal Co., First National Bank Bldg., Pittsburgh
United Connellsville Coke Co., Oliver Bldg., Pittsburgh
The Vesta Coal Co., Third Ave. and Ross St., Pittsburgh
McCauley Coal Co., Pittston
Yost Mining Co., Pittston
Roaring Run Mining Co., Plainsville
Parrish Coal Co., Plymouth
The Penker Coal Co., Portage, R. D.
Philadelphia & Reading Coal & Iron Co., Pottsville
Anita Coal Mining Co., Punxsutawney
Bowersville Coal Co., Punxsutawney
Cortez Coal Co., Punxsutawney
John McLeavy & Co., Punxsutawney
Geo. Pearce & Sons, Puritan
Bulah Coal Co., Ramey
Bulah Shaft Coal Co., Ramey
Girard Mammoth Coal Co., Ravenrun
Jermyn & Co., Rendham
Irvona Coal & Coke Co., Rosebud
Butcher Creek Coal Co., St. Clair
Mount Hope, Coal Co., St. Clair
The St. Clair Coal Co., St. Clair
Shawmut Mining Co., St. Marys
Bowman Coal Mining Co., Saltsburg
M. S. Kemmerer & Co., Sandy Run
Lincoln Coal & Coke Co., Scottdale
Carney & Brown Coal Co., Dunmore, Scranton
The Delaware, Lackawanna & Western R. R Co., Mining Dept., Scranton
Dolph Coal Co., Ltd., Scranton
Hillside Coal & Iron Co., Dunmore, Scranton
Nay Aug Coal Co., Scranton
Pennsylvania Coal Co., Dunmore, Scranton
Peoples Coal Co., Scranton
Scranton Coal Co., Scranton
Oxford Coal Co., Shaft
H. H. Smith & Co., Shaft
Greenough Red Ash Coal Co., Shamokin
Shipman Coal Co., Shamokin
Thomas Colliery Co., Shenandoah
J. B. Anderson & Son, Shickshinny
Baxter Ridge Coke Co., Smithfield
Leland Coal Mining Co., Smokerun
Consolidation Coal Co., Somerset
H. C. Stineman, South Fork
O. M. Stineman, South Fork
H. A. Underwood, Strattonville
East Deer Coal Co., Tarentum
D. L. Ruff, Tarrs
Price Pancoast Coal Co., Throop
Brownsville Coke Co., Uniontown
Hope Coke Co., Uniontown
Hustead-Semans Coal & Coke Co., Uniontown
Olive Coal Co., Uniontown
W. J. Parshall, Uniontown
Prospect Coal & Coke Co., Uniontown
South Fayette Coke Co., Uniontown
Waltersburg Coke Co., Uniontown
Whyel Coke Co., Uniontown
Vinton Colliery Co., Vintondale
Genuine Connellsville Coke Co., Waltersburg
Lackawanna Coal & Coke Co., Wehrum
A. J. Lundquist & Co., Wellsboro R. D.
H. W. White, Whites Valley
Midvalley Coal Co., Wilburton
Coxe Bros. & Co., Inc., Wilkes-Barre
Lehigh Valley Coal Co., Wilkes-Barre
Susquehanna Coal Co., Wilkes-Barre
Sampson & Hormel, Pittsburgh, Wilkinsburg Br. P. O.
Berwind-White Coal Mining Co., Windber
W. J. Stein, Woodville
*Jefferson & Clearfield Coal & Iron Co., Rochester, N. Y.
*Rochester & Pittsburgh Coal & Iron Co., Rochester, N. Y.
*Warner-Leonard Coal Co., Cleveland, Ohio
*Atlas Coke Co., Works at Helen, Pa., Leetonia, Ohio

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*These companies have collieries in Pennsylvania.

PATTERNS AND FLASKS

International Motor Co., Allentown
Penn. R. R. Co. (Foundries), Altoona
Penn. R. R. Co. (Juniata Shops), Altoona
The Autocar Co., Ardmore
S. Flory Mfg. Co., Bangor
Keystone Driller Co., Beaver Falls
Hertzler & Zook Co., Belleville
Gruber Wagon Works, Bernville
Blairsville Enamelware Co., Blairsville
Herman & Hassert, Inc., Bloomsburg
Improved Traction Engine Co., Boynton
West Penn. Steel Co., Brackenridge
Braddock Machine & Mfg. Co., Braddock
Blaisdell Machinery Co., Braddock
Bovaird & Seyfang Mfg. Co., Bradford
Standard Cast Iron Pipe & Foundry Co., Bristol
Logan Iron & Steel Co., Burnham
Standard Steel Works Co., Burnham
California Foundry & Machine Co., California
American Welding Co., Carbondale
The Carbondale Mch. Co., Carbondale
Chambersburg Engineering Co., Chambersburg
The Wolf Co., Chambersburg
Cherry Tree Iron Works, Cherry Tree
American Steel Foundries, Chester
Federal Steel Foundry Co., Chester
Penn. Steel Casting & Machine Co., Chester
Clearfield Fire Brick Co., Clearfield
Clearfield Machine Shops, Clearfield
Harbison Walker Ref. Co., Clearfield
Luckens Iron & Steel Co., Coatesville
Freed Heater Co., Inc., Collegeville
The Keeley Stove Co., Columbia
Coraopolis Mfg. Co., Coraopolis
Shamburg & Allen Mach. Co., Coraopolis
Downingtown Mfg. Co., Downingtown
Westinghouse Electric Mfg. Co., East Pittsburg
Pennsylvania Iron Works Co., Eddystone
The Eddystone Mfg. Co., Eddystone
A. Buch's Sons Co., Elizabethtown
L. L. Fisk, Emporium
General Electric Co., Erie
National Foundry Co., Erie
Frank R. Glisson, Exton
Fleetwood Metal Body Co., Fleetwood
American Steel Foundries, Franklin
Wm. Shimer, Son & Co., Freemansburg
Buffalo & Susquehanna R. R., Galeton
Pittsburgh Steel Foundry, Glassport
The Kelley & Jones Co., Greensburg
The W. O. Hickok Mfg. Co., Harrisburg
Wilmot Engineering Co., Hazleton
McLanahan-Stone Mach. Co., Hollidaysburg
Hyde Park Foundry & Machine Co., Hyde Park
Pa. Rubber Co., Jeannette
F. & E. Trump, Jersey Shore
Cambria Steel Co., Johnstown
The Lorain Steel Co., Johnstown
American Road Machine Co., Kennett Square
Orenstein Arthur Koppel Co., Koppel
Crucible Steel Casting Co., Lansdowne
Sanitary Co., of America, Linfield
Rosenfranz Machine Co., McKeesport
Taylor-Wilson Mfg. Co., McKees Rocks
Johnetta Fdy. & Machine Co., Marianna
Robinson Mfg. Co., Muncy
Sprout, Waldron & Co., Muncy
Union Spring & Mfg. Co., New Kingston
The Alan Wood, Iron & Steel Co., Norristown
Norris Pattern and Machine Co., Norristown
National Transit Co. Shops, Oil City
Oil Well Supply Co., Oil City
Osceola Silica & Fire Brick Co., Osceola Mills
S. B. Stine, Osceola Mills
New Jersey Zinc Co., Palmerton
American Bridge Co. and Pencoyd Iron Works, Pencoyd
Geo. R. Allen, 13th & Buttonwood, Philadelphia
American Pattern Works, 3336 Market St., Philadelphia
Edwin A. Anderson, 203 Quarry St., Philadelphia
The Baldwin Locomotive Works, 500 N. Broad St., Philadelphia
James Barker, Inc., Sixth & Cayuga, Philadelphia
Charles P. Biggin Co., 1829 Harlan St., Philadelphia
E. Bromily & Son, Orthodox & Gaul, Philadelphia
Edw. L. Calely, 945 Ridge Ave., Philadelphia
Clarks Iron Foundry, 35th & Grays Ferry Road
Frank P. Cooper, 130 Reed St., Philadelphia
Oliver I. Dill, 406 N. Tenth St., Philadelphia
The Eynon Evans Mfg. Co., 15th & Clearfield, Philadelphia
Fairmount Patterns Works, 1922 Brandywine St., Philadelphia
Richard Fields, 814 Buttonwood, Philadelphia
R. G. Fleischmann, 407 Cherry St., Philadelphia
Girard Iron Works, 22d & Master Sts., Philadelphia
John Grass Wood Turning Co., 222 Vine St., Philadelphia
George G. Gumpert, 240 Cherry St., Phila.
Hale & Kilburn Co., 18th & Lehigh Ave., Philadelphia
William L. Halsam, 506 N. 12th St., Philadelphia
Edw. Harrington, Son & Co., 17th and Callowhill, Philadelphia
William C. Hormel, 1407 Vine St., Philadelphia
Humphreys Christman Co., 635 N. Watt St., Philadelphia
Thomas J. Hunter Co., 148 N. 7th St., Philadelphia
Walter S. Kalbach, 2227 Wood St., Philadelphia
T. B. Luzier & Son, 1645 N. 10th St., Philadelphia
John McConville, 215 N. 2d St., Philadelphia
H. A. May Foundry Co., 30th & Chestnut Sts., Philadelphia
Meerbach & Schneider, 1612 Vandyke St., Philadelphia
Thos. Mills & Bro., Inc., 1301 N. 8th St., Philadelphia
Frank Pettit Ornamental Iron Works, 809 Master St., Philadelphia
Quaker City Pattern Works, 504 N. 12th St., Philadelphia
Isaac A. Sheppard & Co., Erie Ave. & Sepviva, Philadelphia
J. Thompson & Co., Van Horn & Sophia Sts., Philadelphia
Tioga Foundry Co., 22d & Allegheny, Philadelphia
Union Machine Works & Iron Fdy., 1821 S. Water St., Philadelphia
V. W. Mfg. Co., 1616 North St., Philadelphia
W. J. Webb, 821 Cherry St., Philadelphia
Wm. Wharton, Jr. & Co., Inc., 25th & Washington Ave., Philadelphia
Wickes Bros., Philadelphia
Phoenix Iron Co., Philadelphia
Phoenix Machine Co., Phoenixville
American Steel Foundries, 36th & A. V. Ry., Pittsburgh
Axthelm Mfg. Co., 242 Third Ave., Pittsburgh
Best Mfg. Co., Pittsburgh
Thomas Carlins Sons Co., 1600 River Ave., Pittsburgh
Duquesne Steel Foundry Co., 1104 Arrott Bldg., Pittsburgh
Epping-Carpenter Co., 41st & A. V. Ry., Pittsburgh
Fort Pitt Mal. Iron Co., Box No. 1054, Pittsburgh
Iron City Sanitary Mfg. Co., 1514 Oliver Bldg., Pittsburgh
Lewis Foundry & Machine Co., Box. No. 1597, Pittsburgh
McConway & Tooley Co., 48th & A. V. Ry., Pittsburgh
McDowell & Co., Galveston & Western, N. S., Pittsburgh
Mackintosh, Hemphill & Co., 12th & Etna Sts., Pittsburgh
The Marine Mfg. & Supply Co., Water St., Pittsburgh
The Phoenix Glass Co., Box 757, Pittsburgh
Pittsburgh Elec. & Mch. Wks., Barker Place, Pittsburgh
Pittsburgh Malleable Iron Co., Pittsburgh
H. K. Porter Co., 49th & A. V. Ry., Pittsburgh
G. & J. Rieseck, 16th St., Pittsburgh
Sigwart & Rolston Mch. Works, Cor. Garrison Place & Duquesne Way, Pittsburgh
The Simonds Mfg. Co., 25 Liberty Sts., Pittsburgh
Slentz Mfg. Co., 326 3rd Ave., Pittsburgh
Sommerfield Mach. & Mfg. Co., 216 2d Ave., Pittsburgh
Standard Pattern Co., 28th St., Pittsburgh
Union Fdy. & Machine Co., Pittsburgh
Union Switch & Signal Co., Braddock Ave., Swissvale, Pittsburgh
H. R. Walter Lbr. Co., Fayette & Manhattan Aves., Pittsburgh
Punxsutawney Fdry. & Machine Co., Punxsutawney
Roberts, Winner & Co., Quakertown

PATTERNS AND FLASKS—Continued

Philadelphia & Reading Ry. Co., Reading
The S. G. V. Co., Reading
John G. Speidel, Reading
Buckwalter Stove Co., Royersford
Grander Stove Co., Royersford
S. G. Barker & Son, Scranton
Delaware, Lackawanna & Western R. R. Co., Scranton
The National Malleable Castings Co., Sharon
Sharon Foundry Co., Sharon
Bethlehem Steel Co., South Bethlehem
Keystone Stove Fdy., Spring City
The Pennsylvania Steel Company, Steelton
Union Switch & Signal Co., Pittsburgh, Swissvale Br. P. O.
Messinger Mfg. Co., Tatamy
The Westinghouse Machine Co., Trafford
Verona Steel Castings Co., Verona
Frick Co., Waynesboro
Geiser Mfg. Co., Waynesboro
Landis Machine Co., Waynesboro
Landis Tool Co., Waynesboro
General Refractories Co., West Decatur
Lehigh Valley Coal Co. & Coxe Bros. & Co., Inc., Wilkes-Barre
Vulcan Iron Works, Wilkes-Barre
Simmons Wood Working Co., Williamsport.
Westinghouse Air Brake Co., Wilmerding
Harbison-Walker Ref. Co., Woodland
A. B. Farquhar Co., Ltd., York.
Hench & Drumgold, York
Pullman Motor Car Co., York

PIPES, TOBACCO

William Kaffer, 1128 N. Orianna, Philadelphia
L. Nax, 146 Noble, Philadelphia
Shaw & Leopold, Randolph & Montgomery, Philadelphia

PLANING MILL PRODUCTS

(Including Sash, Doors and Blinds, and General Millwork)

W. M. Stover, Aaronsburg
A. A. Albright & Son, Allentown
Butz-Frederick & Co., Allentown
Altoona Concrete Construction & Supply Co., Altoona
Altoona Construction Co., Altoona
H. S. & C. S. Barthey, Altoona
D. Counsman & Son, Altoona
R. D. Elder Lumber Co., Juniata (Br. P. O.,) Altoona
J. B. Fluke & Son, Altoona
J. C. Ivory, Altoona
Penn. Railroad Car Shops, Altoona
Penn. Railroad Juniata Shops, Altoona
H. S. Nunemaker, Alum Bank
Ohio Valley Lumber Co., Ambridge and Economy
East Penn. Lumber Co., Inc., Analomink
D. L. Saylor & Sons, Annville
W. W. Wallace & Co., Apollo
Adam Waldner, Ashland
Babcock Lumber Co., Ashtola
J. J. Weber, Ashville
Comeby & Harris, Athens
C. F. Thayer, Atlantic
H. J. Hawthorn, Bainbridge
Samuel F. Friedline, Bakersville
John Stauffer, Bally
Bangor Lumber Manufacturing Co., Bangor
Wise Lumber & Coal Co., Bangor
Barnesboro Lumber Co., Barnesboro
T. F. Polley, Bear Lake
Anderson & Cook, Beaver.
Beaver Falls Planing Mill Co., Beaver Falls
Commercial Sash & Door Co., Beaver Falls
J. S. Mitchell & Sons, Beaver Falls
Rhodes & Garvin, Beaver Falls
Reed & Spaid, Beavertown
Arnold Plaining Mill, Bedford
Bedford Planing Mill Co., Bedford.
Bellefonte Lumber Co., Bellefonte
P. B. Crider & Son, Bellefonte
T. R. Hamilton, Bellefonte
Belle Vernon Planing Mill Co., Belle Vernon
Joseph M. Young & Co., Belleville
Jonas Benfer, Benfer
R. T. Smith & Son. Benton
Berwick Lumber & Supply Co., Berwick
Harry Fahringer, Berwick
Berwyn Millwork & Lumber Co., Berwyn
E. L. Lawver, Biglerville.
Andre Lumber Co., Blairsville
Columbia Plate Glass Co., Blairsville
A. B. Hartman, Bloomsburg
Richter Bros., Blossburg
H. A. Cline, Bolivar
S. W. McLean, Bolivar
Eureka Lumber Co., Boswell
Maust Lumber Co., Headquarters, Elk Lick, Boynton
Braddock Lumber Co., Braddock
McBride Bros., Braddock
Price & Alman, Braddock
H. C. Bemis, Bradford
Tuna Manufacturing Co., Bradford
W. H. Mellatt, Breezewood
I. F. March's Sons, Bridgeport
Anderson Lumber Co., Brookville
J. C. Lucas, Brookville
Vanleer Bros., Brookville
Brownsville Construction Co., Brownsville
Irwin Arnold, Buffalo Mills
J. H. Patchin, Burnside
Butler Planing Mill Co., Butler
Cornelius Lumber Co., Butler
John R. Powell's Sons, California
C. W. Blystone & Son, Cambridge Springs
Phoenix Novelty Co., Cambridge Springs
G. M. Coon, Canton
H. Crawford & Sons, Canton
The Holt Lumber Co., Carbondale
J. A. Hoole, Carbondale.
Robert F. Nemire, Carbondale
N. B. Robinson, Carbondale
The Beetem Lumber & Manufacturing Co., Carlisle
Carnegie Mill & Lumber Co., Carnegie
H. J. & W. A. Krumenacker, Carrolltown, R. D.
G. M. Green, Cassville
Franklin Goldsmith & Son, Catasauqua
Zettle Bros., Center Hall
A. C. Kelly, Center Moreland
G. S. Cole, Center Road Station
C. P. Blackburn, Cessna, R. D.
Blair & Raifsnider, Chambersburg
J. A. Hollinger, Chambersburg
Geo. A. Minnick & Son, Chambersburg
H. O. Swartzwelder, Chaneysville
Charleroi Lumber Co., Charleroi
Walton Lumber Co., Inc., Charleroi
J. A. Phillips & Co., Cheltenham.
Stracey G. Glauser & Son, Chester
James M. Hamilton, Chester
B. W. Kinports, Cherry Tree
E. Somerville, Cherry Tree
P. G. Frederick Co., Chicora
Davis Lumber & Planing Mill, Christiana
Waugaman Manufacturing Co., Clarendon
J. C. McElhattan, Clarion
Summit Lumber Co., Clarks Summit
F. J. Egan, Claysville
Clearfield Millwork & Lumber Co., Clearfield
Gearhart & Wrigley, Clearfield
Samuel State, Cloe
S. Hagarty's Sons, Coalport
J. W. Meyer, Coburn
Andrew Vonada, Coburn
Shafer Bros. & Nelson, Cochranton
J. Jay Wisler, Columbia
E. E. Peckham, Columbia Cross Roads
Confluence Lumber Co., Confluence
R. H. DeArment, Conneaut Lake
V. H. Dennis, Conneaut Lake
Moss Bros, Conneaut Lake
Connellsville Planing Mill Co., Connellsvillle
Fayette Lumber Co., Connellsville
Keystone Planing Co., Connellsville
South Connellsville Lumber Co., Connellsville
Wm. Potts Jones, Conshohocken
The A. L. Miller Co., Conshohocken
Isaac D. Shaffer, West Conshohocken Conshohocken

PLANING MILL PRODUCTS—Continued

The A. L. Miller Co., Conshohocken
Wm. Shilling, Cool Spring
McKown & Beattie, Coraopolis
H. A. Button, Coudersport
James S. Swinley, Cowanesque
Ingram Lumber & Supply Co., Pittsburgh, Crafton (Br. P. O.)
Ed O'Brien, Cresson
George C. Abraham, Damascus
Danville Lumber Co. (Mill at Milanville), Danville
Collingdale Millwork Co., Darby.
Stubbs & Culp, Delta
Denver Planing Mill, Denver
Allen Lumber Co., Donora
H. E. Quickel, Dover
Frank J. Gerlitzki, Doylestown
F. L. Worthington, Doylestown
J. C. Doyle, Dry Run
A. D. Orner Woodworking Co., Dubois
G. W. Piper Sons, Dubois
George Smyers, Dubois
George H. Bingham, Scranton, Dunmore (Br. P. O.)
Ziegler Lumber Co., Duquesne
Graham Lumber Co., East Brady
Fitzgerald-Speer Co., Easton
J. Monroe Young, Easton
Rutter Bros., 225 Monroeville Ave., Turtle Creek, East Pittsburgh
East Stroudsburg Lumber Co., Inc., East Stroudsburg
S. M. Milliken, East Waterford
Ebensburg Planing Mill Co., Ebensburg
Robert J. Wade, Edinboro
Elizabeth Planing Mill Co., Elizabeth
H. H. Brant, Elizabethtown
I. T. Buffington, Elizabethville
National Supply & Construction Co., Ellwood City
Uriah Sloan's Planing Mill, Emlenton
L. L. Fisk, Emporium
B. T. Gealy, Enon Valley
Ephrata Planing Mill Co., Ephrata
George Carroll & Bro. Co., Erie
The Constable Bros. Co., Erie
A. A. Deming, Erie
Lyman Felheim, Erie
James D. Johnson & Co., Erie.
Kirchner Bros., Erie
D. S. Milloy, Erie
D. Schlosser Co., Erie
Henry Shenk Co., Erie
Collins Bros., Espyville
The Edward Dambach Co., Evans City
Earlston Planing Mill Co., Everett
Everett Planing Mill Co., Inc., Everett
Export Lumber Co., Export
McCormick Lumber Co., Fairchance
B. F. Beers, Fallentimber
Falls Creek Planing Mill Co., Falls Creek
Fawn Grove Lumber Co., Fawn Grove
James Patterson, Fayette City
Finleyville Planing Mill Co., Finleyville
A. T. Mulinx, Lincoln Falls, Forksville R. D.
Joe S. Rotz, Fort Loudon
Haupt Bros. & Co., Frackville
American Steel Foundries, Franklin
The James Lumber Co., Franklin
Marsteller Bros. Lumber Co., Fredonia
W. T. Mohler, Freedom
Freeport Planing Mills Co., Freeport
A. King & Sons, Freeport
Freidens Planing Mill Co., Friedens
M. Schultz, Gallitzin
Albert Adsit, Geneva
W. L. Adsit, Geneva
George W. Stolsmith, Gettysburg
Glassport Lumber Co., Glassport
Glen Manufacturing Co., Glen Rock
Glen White Coal & Lumber Co., Glenwhite
W. G. Doughman, Grampian
Greencastle Elevator Co., Greencastle
J. C. Reed, Greensburg
South Greensburg Lumber Co., Greensburg
Struble & Walthour, Greensburg
Chas. C. Baker, Greenville
Heilman Lumber Co., Greenville
King Planing Mill & Supply Co., Grove City
McKay Gilmore Furniture Co., Grove City
L. B. Walbert, Hancock
John F. Rohrbaugh & Co., Hanover
Union Planing Mill Co., Inc., Harrisburg
E. B. Koons, Harveyville
Stuttmatter Bros., Hastings
Atkinson Box & Lumber Co., Hawley
H. F. Bright Lumber Co., Hazleton
Hazleton Manufacturing Co., Hazleton.
Kellmer Piano Co., Hazleton
Pennsylvania-Maryland Coal Co., Heilwood
Herndon Manufacturing Co., Herndon
James B. Condron, Hollidaysburg
M. S. Hunter & Sons, Hollidaysburg
Noah Ott, Hollsopple
M. H. Risinger, Homer City.
Feath & Kerr, Homestead
George M. Hall & Co., Homestead
Homestead Lumber Co., Homestead
Pennarden Manufacturing Co., Honesdale
H. G. Hamer, Hooversville
Chas. E. Pletcher, Howard
M. Gillis, Hughesville.
Huntingdon Millwork & Lumber Co., Huntingdon
W. J. O'Mara, Huntingdon
W. F. Laidig, Hustontown
Benjamin Gilson, Hydetown
James M. Ahlburn, Hyndman
Hillegas & Rush, Hyndman
W. S. Daugherty, Indiana
Indiana Lumber & Supply Co., Indiana
W. K. Sparks, Indian Head
Irwin Lumber Co., Irwin
M. J. Snodgrass, Jamestown
T. H. Hazlett Lumber Co., Jeannette
Union Planing Mill & Lumber Co., Jeannette
W. C. Nicholson & Co., Jermyn
Camerer & Lambert, Jersey Shore
Cambria Steel Co., Johnstown
Conemaugh Lumber Co., Johnstown
Johnstown Millwork & Lumber Co., Johnstown
Johnstown Planing Mill Co., Johnstown
The Thomas Kinzey Lumber Co., Johnstown
The Lorain Steel Co., Johnstown
David Ott & Co., Johnstown
Wm. H. Smith Bros., Johnstown
Levi M. Thomas, Thomas Mill, Johnstown P. O.
Kane Blind & Screen Co., Kane
Peterson & Skooglund, Kane
Emporium Lumber Co., Keating Summit
C. G. Gawthrop Co., Kennett Square.
J. F. Seward & Co., Wilkes-Barre, Kingston (Br. P. O.)
John B. Senger & Sons, Kinzers
P. S. Patterson, Kirby R. D.
American Planing Mill Co., Kittanning
Heilman Bros. Lumber Co., Kittanning
Henry Shaffer Lumber Co., Kittanning
West Kittanning Lumber Co., Kittanning
W. W. Bowman, Knox
I. M. Edgecomb's Sons, Knoxville
H. F. Kreamer, Kreamer
Heffner & Savage, Kutztown
J. H. Kirk & Co., Kylertown
A. L. Vandervort, Laceyville
Whipple Bros., Laceyville
John F. Johnson, Laidig
Herr, Draper & Co., Lancaster
Keystone Planing Mill Co., Lancaster
The Wohlsen Planing Mill Co., Lancaster
Jacob W. Dresher, Lansdale
Wm. C. Shuster, Jr., Landsdowne
George C. Anderson & Sons, Inc., Latrobe
Miller Bros., Inc., Lebanon
Leechburg Lumber Co., Leechburg
Lehighton Lumber Co., Lehighton
E. K. Frazer, Lemoyne
H. M. Stauffer, Leola
Le Raysville Furniture & Toy Mfg. Co., Le Raysville
Kulp Planing Mill Co., Lewistown
R. N. Miller, Liberty
Lohr Bros., Ligonier
International Silo Co., Linesville
Keath-Shields Planing Mill Co., Lititz
Neidmyer Bros., Lititz
C. F. Bucher, Littlestown
George R. Julius & Bro., Littlestown
K. D. Batchelder, Lock Haven
Clinton Furniture Co., Lock Haven
Hipple Estate, Lock Haven
H. W. Ruggles, Wilkes-Barre, Luzerne (Br. P. O.)
Frank L. Underwood, Luzerne
N. F. Shillingford, McAllisterville
P. F. Black, McConnellsburg
Wm. S. Clevenger, McConnellsburg
Spangler & Harris, McConnellsburg
Downie & McCord, McKeesport
John Calvert, McKees Rocks
John Davis & Co., McKees Rocks
Elmer Nesbitt, McLane

Nathan Shelly, Manheim
Hummer Bros., Manheim
E. L. Grabble, Manor
S. M. Blakeslee, Manorville
George Zacherl, Marble
B. F. Heistand & Sons, Marietta
M. A. Snyder, Markleton
The Mars Land & Lumber Co., Mars
Bolger Graffius & Co., Martinsburg
Chas. Neast & Co., Mauch Chunk
George H. Cutter Lumber Co., Meadville
The Walter G. Harper Lumber Co., Meadville
Miller & Devore, Meadville
Mill Run Lumber Co., Meadville
W. E. Morrison & Son, Meadville
L. F. Smith, Meadville
George W. Sauter, Menges Mills
D. W. Faust & Sons, Mercersburg
O. H. Allen, Meshoppen
J. M. Stillwell, Meshoppen
Meyersdale Planing Mill, Meyersdale
Kern & Triss, Middleburg
Aaron Stetler's Estate, Middleburg
John E. Brindle, Mifflin
Enoch Miller, Mifflinburg
Elmer C. Rudy, Mifflinburg
Rowe Bros., Milford
A. Douden Planing Mill Co., Millersburg
Millersburg Manufacutring Co., Millersburg
J. F. Kerr, Marsh Run, Millerstown P. O.
Ruhl & Watson, Millmont
C. A. Swetland, Mills
Bennett Lbr. & Mfg. Co., Pittsburgh, Millvale (Br. P. O.)
L. W. Waterhouse, Mill Village
Edward Buck, Millville
Orville Robbins, Millville
D. Clinger & Sons, Milton
Jacob Fetter's Sons, Milton
Anthracite Lumber Co., Minersville
Motz Lumber Co., Monessen
Westmoreland Lumber Co., Monessen
Monongahela Saw & Planing Mill Co., Monongahela
Yohe Bros., Monongahela
Penn Furniture Co., Montgomery
William T. Lundy, Montoursville
W. H. Lundy, Montoursville
Spring Brook Lumber Co., Moosic
L. W. Hart, Morris
P. H. Hart, Nauvoo, Morris P. O.
T. B. Stockham & Bro., Morrisville
C. P. Van Brunt Manufacturing Co., Moscow
Geiger Gibson & Co., Mount Carmel
Mount Carmel Lumber Co., Mount Carmel
Lemley Bros., Mount Morris
H. J. Heiser (Mill at Shadle), Mount Pleasant Mills
A. S. Welsh, Mount Union
Edward F. Ives, Muncy
Isaac B. Haak, Myerstown
S. B. Price & Co., Nanticoke
Susquehanna Lumber Co., Nanticoke
Nazareth Planing Mill Co., Nazareth
C. O. Solomon, New Berlin
R. B. McDanel Co., New Brighton
Maitsoff Bros. Co., New Brighton
D. H. Fair, New Buena Vista
Kline Lumber & Construction Co., New Castle
Mahoning Valley Lumber Co., New Castle
New Castle Lumber & Construction Co., New Castle
Shenango Lumber Co., New Castle
Wallace Bros., Mahoningtown Sta., New Castle
Thomas Kirscher, New Florence
W. E. Jones, New Park
Newport Planing Mill, Newport
A. W. & W. M. Watson Co., Newtown
George & Clyde Pratt, Nicholson
Rought-Wright Co., Nicholson and Factoryville
H. J. & Wm. Krunenacker, Nicktown
W. A. Baier, Nisbet R. D.
Grater Body Co., Norristown
Stow Lumber & Coal Co., North East
O. M. Webber Co., Inc., North Wales
Lillo Bros. Co., Oakdale
C. F. Reed & Bro., Oakmont
J. W. Bailey, Ohiopyle
Borland & Dimond Lumber Co., Oil City
Caldwell Lumber Co., Oil City
United Lumber & Coal Co., Oil City
Wilson & Carothers, Orbisonia
L. F. Mickley, Orrtanna
Osceola Lumber Co., Osceola Mills
R. J. Walker,, Osceola Mills
Wm. Adams, Osterburg
Harry Hilaman, Oxford
W. G. Sigler, Paintersville
New Jersey Zinc Co. (of Pennsylvania), Palmerton
Early & Wengel, Palmyra
Palmyra Woodwork Manufacturing Co., Palmyra
Wm. Potts & Son, Parkersburg
A. P. Reid, Parkersburg
J. W. Logan & Sons, Parnassus
Twist & Hippensteel, Wilkes-Barre, Parsons (Br. P. O.)
Fitzgerald-Speer Co., Pen Argyl
Harry Shaffer, Penn Run
Pennsburg Manufacturing Co., Pennsburg
J. E. Myers, Penns Station
C. P. Fox, Perkasie
S. K. Slonecke, Perkiomenville
Daniel Adams, 2940 North Marshall St., Philadelphia
Ellwood Allen Lumber Co., Trenton Avenue & Ann St., Philadelphia
Isaac Ambrose, 1118 Siebel, Philadelphia
Chas. A. Anderson, 1629 North 10th St., Philadelphia
Bailey & Co., 210 New St., Philadelphia
John Barber, 220 Chancellor St., Philadelphia
Gustave Berger, 1143 N. Front Street, Philadelphia
John M. Cromwell, 1136 Harrison Street, Philadelphia
D. R. Crumrine, 301 Edgewood, Philadelphia
E. M. Culbertson & Son, 2328 N. Sydenham St., Philadelphia
John A. Dubs, 269 S. Fifth St., Philadelphia
Esenwein & Boorse, 1019 W. Susquehanna Ave., Philadelphia
Chas. Feline & Co., York Road and Butler, Philadelphia
Fite & Arbelo Co., 20th and Glenwood, Philadelphia
Fritz & La Rue, 1124 Chestnut St., Philadelphia
Frederick Gerry & Co., Schuylkill Ave. and Peltz Street, Philadelphia
Wm. E. Gibson, 3527 Market St., Philadelphia
T. H. Grigg, Lancaster Ave. and Baring St., Philadelphia
Hale & Kilburn Co., 18th Street and Lehigh Ave., Philadelphia
Hall Bros. & Wood, 54th and Lancaster Ave., Philadelphia
Edward F. Henson & Co., 921 N. Delaware Philadelphia
Hoeling Bros., 314 S. Lawrence, Philadelphia
Ernest Hoffman (Est), 1124-32 Washington Ave., Philadelphia
Solomon Horn, 615 Pine Street, Philadelphia
Chas. D. Hughes, 3072 Janney St., Philadelphia
Joseph W. Janney, 1147 Beach St., Philadelphia
Jones, Doll & Co., 203 North 22d Street, Philadelphia
S. S. Keely & Sons, Main and Umbria Streets, Philadelphia
Kensington Planing Mill, 1925 E. York Street, Philadelphia
Louis Kirchgraber, 613-15 Cherry St., Philadelphia
Charles B. Kline, 28 South 16th Str., Philadelphia
George W. Kugler & Sons Co., 919 New Market Street, Philadelphia
Dudley W. Lance, 721 W. Tioga St., Philadelphia
Richard Lloyd, 105 North 22d St., Philadelphia
T. B. Luzier & Son, 1645 North 10th Street, Philadelphia
Joseph Miles, River Road, Manayunk Station, Philadelphia
A. F. Miller, 239 S. Hutchinson, Philadelphia
Peter C. Osada & Co., 1422 S. Front Street, Philadelphia
John Parker & Son, 16th and Fitzwater Streets, Philadelphia
Pennsylvania Sash and Door Co., 25th and Callowhill Streets, Philadelphia
Philadelphia Screen Manufacturing Co., 56th Street and Woodland Avenue, Philadelphia
Stacey Reeves & Sons, 1611 Filbert Street, Philadelphia
A. W. Renninger, 2309 North 6th St., Philadelphia
William Russel Woodworking Co., 3015-29 Chestnut Street, Philadelphia
Seymour Bros., 3402 Lee Street, Philadelphia
Sheip & Vandergrift, Inc., 814-832 W. Lawrence Street, Philadelphia

PLANING MILL PRODUCTS—Continued

Silberman & Fleisher, 1218 Mascher Street, Philadelphia
Smedley Bros. Co., Church and Tacony Streets, Frankford Sta., Philadelphia
George W. Smith & Co., Inc., 3907 Powelton Ave., Philadelphia
Frank C. Snedaker & Co., 9th and Tioga Sts., Philadelphia
Robert Tarle & Son, 413-17 S. Fifth Street, Philadelphia
Tucker & Staehle, 167 East Allen St., Philadelphia
William I. Underwood & Co., Cottman and Keystone Sts., Tacony Sta., Philadelphia
Martin H. Walrath, Broad and Cambria Sts., Philadelphia
Joseph T. Ward, 5809-19 Baynton Street, Philadelphia
Watson & Robinson, 49 Queen Street, Germantown Sta., Philadelphia
A. Wilt & Sons, 721 N. Front St., Philadelphia
Fred V. Yeager, 9-13 S. 36th St., Philadelphia
D. Grebe & Son, Philipsburg
Phillipsburg Planing Mill Co., Philipsburg
Phoenix Machine Co., Phoenixville
George C. Fry & Son, Picture Rocks
Chas. Werner, Pine Grove
Lesher Lumber & Supply Co., Pitcairn
Ahlers Lumber Co., 928 E. Ohio St., N. S., Pittsburgh
Ben Avon Lumber Co., Spruce Street & Brighton Road, N. S., Pittsburgh
Robert J. Barnes Co., S 18th & Mary Streets, Pittsburgh
Andrew Bonsen, 150 South 18th St., Pittsburgh
Smith Bovard, 6616 Kelly St., Pittsburgh.
Bruckman Lumber Co., Pittsburgh
Edward A. Caler, 621 Industry St., Pittsburgh
Diebold Lumber & Manufacturing Co., 99 Wabash Street, Pittsburgh
D. M. Diebold Lumber Co., E. Liberty Station, Pittsburgh
G. D. Dubarry & Co., 41st St. & A. V. Ry., Pittsburgh
Eiler Lumber & Mill Co., So. 23rd St., Pittsburgh
Henry J. Frey, Kaiser & Haslage Aves., Pittsburgh
Green & Evans Lumber Co., Ltd., 107 Warrington Ave., Pittsburgh
Jacob Haney, 912 Lincoln St., Pittsburgh
R. W. Hare, 632 Penn Ave., Pittsburgh
L. J. Higgins Lumber Co., 33rd & Liberty Ave., Pittsburgh
Edwin M. Hill, 2601 Penn Ave., Pittsburgh
Interior Finish Co., Beaver Ave. & Fayette St., Pittsburgh
T. W. Jones, 2603 Penn Ave., Pittsburgh
The Keystone Lumber Co., S. 17th & Merriman Sts., Pittsburgh
R. A. McCall Lumber Co., Putnam near Frankstown Ave., Pittsburgh
Frank McFeeley, 520 W. Reliance St., Pittsburgh
The May Lumber Co., 1201 Irwin Ave., Pittsburgh
George B. Monks, 8-12 Ketchum St., N. S., Pittsburgh
North Avenue Stair Co., 809 North Ave., N. S., Pittsburgh
Pittsburgh & Lake Erie R. R., Pittsburgh
Pensylvania Door and Sash Co., 900 Second Ave., Pittsburgh
Phoenix Glass Co., P. O. Box 757, Pittsburgh
A. F. Schwerd Manufacturing Co., 145 McClure Ave., N. S., Pittsburgh
M. Simon's Sons, 121-127 Anderson St., N. S., Pittsburgh
H. R. Walter Lumber Co., Fayette & Manhattan Aves., Pittsburgh
Wigman Lumber Co., S. 18th & Wharton St., Pittsburgh
Young & Schmidt, 3209 Carson St., Pittsburgh

Pittsburgh Branch Post Offices.

Ingram Lbr. & Supply Co., 3 Prospect Ave., Ingram, Crafton, Pittsburgh
Bennett Lbr. & Mfg. Co., 213 Sedgewick St., Millvale, Pittsburgh
Colonial Floor Co., 1840-44, Sharpsburg, Pittsburg
Daniel Whitmore & Co., Hiel Ave., Wilkinsburg, Pittsburgh
Wilkinsburg Stair & Mfg. Co., Penn Ave. & Penn. R. R., Wilkinsburg, Pittsburgh
W. F. Youngk Co., 903 Hay St., Wilkinsburg, Pittsburgh
The Exeter Lumber Co., Inc., Pittston
J. E. Patterson & Co., Pittston
Wyoming Valley Lumber Co., Pittston
J. W. Cook & Sons, Platea
Clark Bros. & Co., Plymouth
John A. Clarke, Point Marion
A. K. Jenkins & Co., Point Marion
Point Marion Lumber Co., Point Marion
Leroy Pearson, Portland
H. G. Miller, Potter Brook
E. S. Potter, Potter Brook
L. M. Moll, Potts Grove
Josiah Frederick, Pottstown
William Buechley & Son, Pottsville
Kreig Bros., Pottsville
The Sailor Planing Mill & Lumber Co., Pottsville
Walter Wertley Cons, Pottsville
James K. Long & Son, Lindsey Station, Punxsutawney
McKean, Hare & Son, Punxsutawney
Peoples Planing Mill, Punxsutawney
Punxsutawney Planing Mill Co., Punxsutawney
Silas Miller, Purcell
G. F. Smith, Purcell
Henry A. Good, Quincy
Neversink Planing Mill, Reading
Northeastern Planing Mill Co., Reading
Philadelphia & Reading Railway Co., Reading
Sheeder Planing Mill Co., Reading
C. C. Bierly, Rebersburg
D. J. Rumbel, Red Hill
Noah C. Stabley, Red Lion
Joseph M. Young & Co., Reedsville
Isaac H. Lebo, Reinholds Station R. D.
Philip Reitz, Reitz
L. D. Stine, Reitz R. D.
Oil City Woodworking Co., Reno
J. H. Baird, Renovo
The Woodward Supply Co., Reynoldsville
Arthur Westgate, Riceville
W. B. Shrawder, Richfield
Hyde-Murphy Co., Ridgway
Riegelsville Mfg. Co., Riegelsville
Wallace A. Hoover, Riverside
Wallace Hoover & Bro., Riverside
Planing Mill Co., Roaring Spring
H. C. Fry Glass Co., Rochester
David Hawk, Rochester Mills
J. P. Growall, Rockwood
Schrock Bros., Rockwood
O. O. West, Rogersville
C. L. Wilmot, Rome
Bush Bros., Royersford
McKelvey & Peters, Rural Valley
Henry Umholtz, Sacramento
Byron W. Stebbins, Saegerstown
Schaut Bros. Manufacturing Co., Saint Mary's
L. H. Knapp, Salona
Kimmell & Cornelius, Saltillo
George H. Rhea, Saltsburg
Baker & Cary, Sayre
I. S. Hart, Sayre
Charles S. Metzgar, Sciota
W. A. Pentz, Scotland
Broadway Planing Mill, Scottdale
J. W. Ruth, Scottdale
John Benore, Scranton
George H. Bingham, Dunmore (Br. P. O.) Scranton
Brown Bros., Scranton
Burcher & Robinson, Scranton
Delaware Lackawanna & Western R. R., Scranton
De Witt Lumber Co., Scranton
Hagen Lumber Co., Scranton
Mason & Snowdon Lumber Co., Scranton
Nay Aug Lumber Co., Scranton
Peck Lumber Manufacturing Co., Scranton
Washburn, Williams Co., Scranton
J. B. Woolsey & Co., Scranton
East End Planing Mill Co., Saxton
Harper Bros., Shade Gap
W. G. Piper, Shade Gap
Ralph W. Barnhart, Shamokin
East End Lumber Co., Shamokin

PLANING MILL PRODUCTS—Continued

H. P. Raup & Sons, Shamokin
Shamokin Lumber Manufacturing Co., Shamokin
W. G. Berkey, Shanksville
Walker & Lowry, Shanksville
Chas. C. Baker, Sharon
John Cook & Son, Sharon
Rine Cook & Son, Sharon
J. M. Hoagland & Co., Sharon
Wallis & Carley Co., Sharon
A. Wishart & Sons Co., Sharon
C. C. Weaver, Sharon
Bixby & Son, Sharon Center
E. L. Gaines & Son, Sharpsville
Frank W. Wiley, Sheakleyville
G. R. Wood's Sons Co., Sheffield
Shickshinny Lumber Co., Shickshinny
D. B. Becker Planing Mill, Shillington
Builders Home Supply Co., Shinglehouse
W. S. Snoke, Shippensburg
J. P. Kilmer & Son, Shunk
C. F. Schulze, Silver Creek
John H. Glassmyer, Sinking Spring
L. L. Texter, Sligo
W. J. Ruble, Ruble Mills, Smithfield P. O.
C. W. Mitchell, Snedekerville
Berkebile Lumber Co., Somerset
Globe Column & Mfg. Co., Somerset
Somerset Door & Column Co., Somerset
Somerset Lumber Co., Somerset
Hemsing & Son, Souderton
Brown-Borhek Lumber Co., South Bethlehem
Robert Pfeifle, South Bethlehem
Perry Gilpin, South Sterling
Geo. H. Lancaster, South Sterling
D. H. Deaner, Springhope
C. P. Long, Spring Mills
Steelton Planing Mill, Steelton
Stewartstown Lumber & Mfg. Co., Stewartstown
John T. Long, Summerhill
Andrew Breslin, Summithill
Tilman Hontz, Summithill
Malick & Erdman, Sunbury
Sunbury Planing Mill Co., Sunbury
Deakin & Ash, Susquehanna
J. B. Sykes, Sykesville
Henry Becker, Tamaqua
J. A. Schilbe, Tamaqua
Hough & Leard Co., Ltd., Tarentum
The Tarentum Lbr. Co., Tarentum
E. H. Harman, Thompsontown
Ben Lesher, Thompsontown
H. C. Mapes, Tionesta
W. C. Harrison, Titusville
D. L. Reuting, Titusville
I. L. Shank, Titusville
Humphrey Mfg. Co., Towanda
D. Snyder & Son, Tower City
Park E. Wood, Townville
F. P. Case & Son, Troy
G. Dow Dewitt, Tunkhannock
A. H. Harris, Tunkhannock
Wm. Grittner, Turbotville
Jno. B. Beam, Tyrone
F. D. Beyer & Co., Tyrone
Perry Bingham, Ulysses
Caflisch Bros., Union City
H. Clark & Son, Union City
Douglass & Yale, Union Dale
Carroll Lumber Co., Uniontown
Chas. F. Eggers, Uniontown
South Penn Bldg. Co., Uniontown
Oglevee, McClure & Co., Vanderbilt
W. J. Reed, Vanderbilt
C. C. Shaffer, Varden
S. Heinly, Virginville
Pickett Lumber Co., Warren
L. D. Wetmore Co., Inc., Warren
Vester, Stewart & Rossell Co., Washington
Walker & Slater, Washington
Watsontown Door & Sash Co., Watsontown
U. G. Stover, Waynesboro
W. F. Blair, Waynesburg
J. A. Culver & Co., Wellsboro
Harkness & Borden, Wellsboro
J. C. & S. A. Spencer, Wellsboro
Wolfenberger & Feather, Wernersville
S. C. Black, West Chester
E. R. & W. H. Griffith, West Chester
Isaac D. Shaffer, West Conshohocken
Luse & Shaull Co., West Fairview
C. E. Neff, West Newton
Wesley L. Beam, West Point
J. C. McQuaid, West View
H. W. White, Whites Valley
The Goff Lumber Co., Wilkes-Barre
Kehoe & Mowery Co., Wilkes-Barre
Conrad Lee, Wilkes-Barre
E. T. Long & Co., Wilkes-Barre
Robbins Lumber Co., Wilkes-Barre
W. H. Shepherd & Son, Wilkes-Barre
The Steinhauer Co., Wilkes-Barre

Wilkes-Barre Branch Post Offices.

J. F. Seward & Co., Kingston, Wilkes-Barre
H. W. Ruggles, Luzerne, Wilkes-Barre
Frank L. Underwood, Luzerne, Wilkes-Barre
Twist & Hippensteel, Parsons, Wilkes-Barre
Hart Planing Mill Co., North Ave. & Pitt St., Wilkinsburg (Br. P. O.) Pittsburgh
Dan'l Whitmore & Co., Wilkinsburg (Br. P. O.)
Wilkinsburg Stair & Mfg. Co., Wilkinsburg (Br. P. O.)
W. F. Youngk Co., Wilkinsburg (Br. P. O.)
F. B. Sherman, Williamsburg
John Coleman, Williamsport
W. D. Crooks & Sons, Williamsport
Goertz Carving Co., Williamsport
Loyalsock Planing Mill Co., Williamsport
Simmons Wood Working Co., Williamsport
William Slack, Williamsport
Vallamont Bldg. & Planing Mill Co., Williamsport
Williamsport Planing Mill Co., Williamsport
Woodworking & Stairbuilding Co., Williamsport
Dominick Genre, Wilmerding
Windber Lumber Co., Windber
D. N. Byers, Woodbury
Ellwood Lumber Co., Woodlawn
I. C. Fuller, Wyalusing
W. John Stevens, Inc., Wyncote
Billmeyer & Small, York
Frederick Blaebaum, York
Henry G. Brockman, York
Codorus Planing Mill, York
Geo. W. Gilbert, York
Home Furniture Co., York
Casper H. Oermann, York
York Woodworking Co., York
Youngsville Lumber Co., Youngsville
Youngsville Planing Mill, Youngsville

PLUMBERS' WOODWORK.

Westmoreland Lumber Co., Monessen
Standard Sanitary Mfg. Co., New Brighton
Hale & Kilburn Co., 18th & Lehigh Ave., Philadelphia
Sanitary Specialties Co., 1824 E. Clearfield St., Philadelphia
Smedley Bros. Co., Church & Tacony Sts., Frankford, Philadelphia
West York Furniture Mfg. Co., York

PRINTING MATERIAL.

The W. O. Hickok Mfg. Co., Harrisburg
Joseph Adams, 1226 N. Alden, Philadelphia
American Electrotype Co., 706 Market St., Philadelphia
American Type Founders, 17 and 19 S. Sixth St., Philadelphia
Chas. S. Belz Co., 14 and 16 S. 5th St., Philadelphia
Duncan & Co., 621 Commerce St., Philadelphia
Franklin Electrotype Co., 224 So. 5th St., Philadelphia
Gatchel & Manning, 6th & Chestnut Sts., Philadelphia
Hanson Brothers, 704 Sansom St., Philadelphia
Royal Electrotype Co., 620 Sansom St., Philadelphia
Henry H. Sheip Mfg. Co., N. E. Cor. 6th St. & Columbia Ave., Philadelphia
Sheip & Vandergrift Co., 816 Lawrence St., Philadelphia
Weskott & Thompson, 112-114 N. 12th St., Philadelphia
Geo. W. White, 721 Walnut St., Philadelphia

PULLEYS AND CONVEYORS.

P. & R. R. R. Repair Shops, Catawissa
Edwards Mfg. Co., Laceyville
Eclipse Pulley Co., Meyersdale
Coliditz-McMinn & Co., 702 W. Canal St., Philadelphia
W. W. Patterson Co., 54 Water St., Pittsburgh
Pittsburgh Block & Mfg. Co., 818 South Ave., North Side, Pittsburgh
Reading Wood Pulley Co., Reading
Bethlehem Steel Co., South Bethlehem

PUMPS.

Connellsville Mch. & Car Co., Connellsville
The Monongahela River Consolidated Coal and Coke Co., 48 Market St., Pittsburgh
G. R. Wood's Sons Co., Sheffield
Standard Wood Pipe Co., Williamsport

REFRIGERATORS AND KITCHEN CABINETS.

J. D. Naftzinger, Centerport
Stevenson Co., Chester
Banta Refrigerator Co., Clearfield
R. F. Kleinginna, Du Bois
W. H. Kelchner, Mifflinville
J. Fisher and Co., 1216-18 N. 5th St., Philadelphia
Hale & Kilburn Co., 18th St. and Lehigh Ave., Philadelphia
John Knoell & Sons, 171 Jefferson St., Philadelphia
A. H. & F. H. Lippincott, Inc., 24th & Locust Sts., Philadelphia
McCracken & Hall, 1120 Washington Ave., Philadelphia
Thos. Mills & Bro., Inc., 1301 N. 8th St., Philadelphia
Ridgway Refrigerator Co., 3519 N. Lawrence St., Philadelphia
C. J. & A. Schad, 519 Bainbridge St., Philadelphia
H. Daniel Long, S. W. Cor. Front & Montgomery St., Philadelphia
Standard Refrigerator Co., 2543-45-47 Germantown Ave., Philadelphia
S. Delp's Sons, Fourth and Liberty Sts., Pittsburgh
Bernard Gloekler Co., 1127 Penn. Ave., Pittsburgh
The Specialty Mfg. Co., Titusville
H. A. Boyer, West Hanover

ROLLERS AND CURTAIN POLES.

Webb Mfg. Co., Brookville
Bernard McCurdy, 9th & Arch Sts., Philadelphia
Smedley Bros. Co., Church & Tacony Sts., Frankford, Philadelphia
Thomas Ott & Co., 1124-1132 Washington Ave., Philadelphia
R. M. Bowser & Son, Renfew
Geo. H. Lancaster, South Sterling

SADDLES AND HARNESS.

Barton Mfg. Co., Ivyland
Eagle Scotch Hame Manufacturers, 235 No. Lawrence St., Philadelphia
H. M. Easterbrook, 311 Cherry St., Philadelphia
Hessler Wagon Works, Inc., 857 E. Girard Ave., Philadelphia

SHIP AND BOAT BUILDING.

A. Long & Son, Albion
Rift Climbing Boat Co., Athens
Ray Hoffman, Bloomsburg
W. N. Foust & Son, Conneaut Lake
Hauser Bros., Delaware Water Gap
Dravosburg Dock Co., Dravosburg
Paasch Bros., Erie
John S. Sheppard, Essington
Harrisburg River, Coal, Sand & Stone Co., Harrisburg
Geo. V. Tompkins, Marcus Hook
The Lehigh Coal & Navigation Co., Mauch Chunk
Collins, Darrah & Co., Nebraska
Wm. Cramp & Sons, Ship & Eng. Bldg. Co., Beach and Ball Sts., Philadelphia
William Glass & Son, 779 N. 28th St., Philadelphia
Wesley Glenn, S. L. Tacony St., Philadelphia
U. S. Navy Yard (Hull Division), Philadelphia
E. F. Ward & Sons, Philadelphia
Hazelwood Dock Co., Pittsburgh
The Monongahela River Consolidated Coal and Coke Co., 8 Market St., Pittsburgh
Neville Dock Co., 1218 Park Building, Pittsburgh
R. C. Price & Co., Foot Federal St., Pittsburgh
James Rees & Sons Co., Pittsburgh
H. R. Walter Lbr. Co., Fayette & Manhattan Aves., Pittsburgh
J. M. Samsel, Point Pleasant
Peck Lbr. Mfg. Co., Scranton
J. P. Coryell, Shamokin Dam
Bethlehem Steel Co., South Bethlehem
Forest Barge Co., Tionesta
U. S. Boat Yards, Lock No. 4
Douglass & Yale, Union Dale
Wyatt Stroman, Yorkhaven

SHUTTLES, SPOOLS, AND BOBBINS.

Allentown Bobbin Works, Allentown
Allentown Reed, Harness & Mill Supply Co., Allentown
Clover Leaf Mfg. Co., Carbondale
Arnold & Bro., Coopersburg
Excelsior Bobbin & Spool Co., Newtown
J. B. Brusher, Norristown
Jas. H. Billington & Co., Randolph & Jefferson Sts., Philadelphia
B. R. Dover, 1126 N. Orianna, Philadelphia

SPORTING AND ATHLETIC GOODS.

A. C. Kelly, Center Moreland
Oneida Community, Ltd., Lititz
Clark Herd Mfg. Co., 2419 Front St., Philadelphia
Chas. P. Foulkrod, 2235 Wood St., Philadelphia
John Grass Wood Turning Co., 222 Vine St., Philadelphia
Frank Rosatto Co., 222 So. 8th St., Philadelphia
Geo. Wuerthele & Sons, 1724 East St., N. S., Pittsburgh
Wm. Wuerthele, 418 Diamond St., Pittsburgh
Geo. H. Rhea, Saltsburg
Holmes & Gilfillan, Smethport
Becker Novelty Co., Spring Creek
J. H. Park, Warren

TANKS AND SILOS.

Penn. R. R. Car Shops, Altoona
P. & R. Ry. Repair Shops, Catawissa
Downington Mfg. Co., Downington
Grater Body Co., Norristown
Amos H. Hall Son & Co., 2915-2933 N. Second St., Philadelphia
E. F. Schlichter Co., 10 S. 18th St., Philadelphia
Woolford Wood Tank Mfg. Co., 1429 Chestnut St., Philadelphia
H. Elsesser & Bros., 1324 Ohio St., N. S., Pittsburgh
Fleming Tank Co., 3115 Liberty Ave., Pittsburgh
H. R. Walter Lbr. Co., Fayette & Manhattan Aves., Pittsburgh
Rouseville Supply Co., Rouseville
John Benore, Scranton
International Silo Co., Linesville
F. P. Case & Son, Troy

TOYS.

Standard Novelty Co., Duncannon
F. W. Crandall & Co., Elkland
Barton Mfg. Co., Ivyland
Benner Mfg. Co., Inc., Lancaster
Glen Mawr Novelty Works, Mawrglen.
Le Raysville Furn. & Mfg. Co., Le Raysville
Mansfield Novelty Works, Mansfield
L. Hopkins Mfg. Co., North Girard
S. L. Allen & Co., 5th St. and Glenwood Ave., Philadelphia
A. Schoenhut Co., 2215 Adams St., Philadelphia
J. T. Hammond & Son, Inc., 4534 Hedge St., Frankford, Philadelphia
A. Mecky Co., 1705 Allegheny Ave., Philadelphia
Penn. Wheelbarrow Co., 4741 Kansas St., Pittsburgh
Weaver Specialty Co., 6344 Aurelia St., E. E., Pittsburgh
Geo. H. Lancaster, South Sterling
Hawes Mfg. Co., Towanda
Keystone Farm Machine Co., York

TRUNKS AND VALISES.

Fiber Specialty Co., Kennett Square
S. J. Bailey, Nicholson
The Belber Trunk & Bag Co., 1641 N. Hancock St., Philadelphia
S. Berkowitz, 1818 So. 9th St., Philadelphia
Robert McGuinn & Co., 437 Market St., Philadelphia
Cramer and Sherr, 123 So. 3rd St., Philadelphia
B. Podol, 1103 N. 2nd St., Philadelphia
J. H. Seitz & Son, 414 & 438 Brown St., Philadelphia
B. B. & B. Trunk Co., 32-40 Isabella St., Pittsburgh
South Montrose Mill Co., South Montrose

VEHICLES AND VEHICLE PARTS.

International Motor Co., Allentown
Est. of W. Wolf, Allentown
Lewis Wolf's Sons, Allentown
Balzer Koelle, Altoona
Russell Delozier, Altoona
Penn. R. R. Co. (Foundries), Altoona
Penn. R. R. Car Shops, Altoona
J. L. Saylor & Son, Annville
T. M. Werner, Annville
The Autocar Co., Ardmore
L. C. Brenner, Bainbridge
W. Ira Baker, Bakersville
W. G. Sterling, Bakerstown
Joseph Litterhouse, Bally
S. S. Lynch, Bausman
Jacob F. Schmitt, Beaver Meadows
J. O. Klinger, Beaver Springs
Bedford Planing Mill Co., Bedford
F. H. Brightbill, Bedford
A. G. Brightbill & Son, Bedford
W. S. Fletcher, Bedford
Isaac K. Meyer, Bedminster
H. J. Horton & Co., Belleville
S. F. Appleman, Benton
Long Wagon Co., Benton
Wm. E. Gruber, Bernville R. D.
Gruber Wagon Works, Bernville R. D.
Trescott Carriage Works, Berwick
A. K. Huntzinger, Blainsport
Edw. Stevens, Bowmansdale
Boyertown Carriage Co., Boyertown
Pittsburgh Machine Tool Co., Braddock
C. A. Adams, Bridgeton R. D.
Chas. B. Sossong Co., Bridgeville
Standard Cast Iron Pipe & Foundry Co., Bristol
J. D. McSparrin, Brockwayville
Brookville Mfg. Co., Brookville
C. W. Scott Co., Bryn Mawr
A. F. Fey, Carbondale
H. J. & W. A. Krumenacker, Carrolltown
A. C. Kelly, Center Moreland
J. G. Reber, Centerport
C. H. Schantz, Center Valley
Walton Lumber Co., Charleroi
M. Ocheltree, Chester
S. M. Congleton, Chester Heights
Schaller Bros., Clark
Clearfield Novelty Works, Clearfield
R. H. Grater, Collegeville
Frank J. Bower, Collomsville
Columbia Wagon Co., Columbia
Coraopolis Mfg. Co., Coraopolis
F. E. Neffe, Coudersport
Z. H. Markley, Cressman
John G. Stoll, Deodate
J. K. Hinkle, Dillsburg
Huston Irwin Mfg. Co., Du Bois
Hobson & Co., Easton
J. Monroe Young, Easton
St. Francis Industrial School, Eddington
C. Prouty & Co., Eldred
C. Bailey & Co., Elimsport
A. Buch's Sons Co., Elizabethtown
Martin & Heagy Mfg. Co., Elizabethtown
Swab Carriage Co., Elizabethville
Swab Wagon Co., Elizabethville
Horace Handwork, Elverson
Acme Wagon Co., Emigsville
J. H. Young Lumber Co., Emlenton
H. N. Thayer Co., Erie
W. C. Laderer, Evans City
F. M. Ott & Son, Everett
B. F. Beers, Fallentimber
S. A. Mowers, Fayetteville
Finleyville Planing Mill Co., Finleyville
Fleetwood Metal Body Co., Fleetwood
Myers Carriage Co., Franklin
A. Reynolds, Franklin
Fredonia Bending Works, Fredonia
R. M. Whitney, Galeton
M. Schultz, Gallitzin
George T. Sellers, Gap
George Keinard, Geigers Mills
D. W. Bryan, Gillett
J. N. Kramer, Coodville
Stoyers Carriage Shop, Greenville
Grim & Bro., Grimville
F. C. Fehrman, Groffs Store
McKay Carriage Co., Grove City
Scott & Kemmerer, Hamburg
Hanover Bending & Mfg. Co., Hanover
Hopkins Mfg. Co., Hanover
Eureka Coal Wagon Co., Harrisburg
C. A. Fair Carriage & Auto Works, Harrisburg
C. A. Sefton Carriage Works, Harrisburg
C. E. Shaffer Est., Harrisburg
Penna. R. R. Co., Harrisburg
F. N. Watts, Harrisburg
Samuel Fahs, Highspire
Jas. B. Condron, Hollidaysburg
Penwarden Mfg. Co., Honesdale
Wm. Nelms, Honey Brook
Bowers & Leathers, Howard
Howard Handle & Spoke Co., Howard
Chas. E. Pletcher, Howard
M. Gillis, Hughesville
Conner Vehicle Co., Indiana
John F. Klein, Ironbridge
T. H. Hazlett Lbr. Co., Jeannette
C. H. Decker, Jersey Shore

VEHICLES AND VEHICLE PARTS—Continued.

Chas. Shoup, Jersey Shore
Conemaugh Lbr. Co., Johnstown
Rauch Handwerk & Co., Jordan
American Road Machine Co., Kennett Square
Jacobs & Colley Wilkes-Barre, Kingston Br. P. O.
H. W. Miller, Kittanning
H. Shaffer Lumber Co., Kittanning
E. R. Kroninger, Kutztown
R. Miller's Sons, Kutztown
Edwin A. Rauer, Kutztown
J. H. Kirk & Co., Kylertown
Roy M. Plank, Lampeter
Samuel E. Bailey, Lancaster
Downey Bros. Spoke & Bending Co., Lancaster
Edwin Edgerly, Lancaster
Michael Hoover, Lancaster
Stoll Bros., Lancaster
S. M. Skeen, Lancaster
John R. Cooper, Landenberg
Automatic Wagon & Truck Co., Lansdowne
Latrobe Carriage Co., Latrobe
Monyar Carriage Co., Latrobe
The Fauber Coach Works, Lebanon
A. F. Heim Carriage Works, Lenhartsville
T. L. Blocker & Sons, Littlestown
S. D. Mehring, Littlestown
Frank L. Underwood, Wilkes-Barre, Luzerne Br. P. O.
N. F. Shillingford, McAlisterville
A. Mauser & Bro., McEwensville
L. Loeffler, McKeesport
Otto Sippel, McKees Rocks
J. W. Gerhard, Macungie
H. P. Frank, Maytown
Sload & Bro., Maytown
The Eberly & Orris Mfg. Co., Mechanicsburg
J. K. Hinkel, Mechanicsburg
J. B. Koller & Co., Mechanicsburg
Fred Seidel Estate, Mechanicsburg
Seidel & Hinkel, Mechanicsburg
Hopp Carriage Co., Mifflinburg
Mifflinburg Body & Gear Co., Mifflinburg.
D. B. Miller, Mifflinburg
Elmer C. Rudy, Mifflinburg
Potter Wagon Works, Mifflintown
Charles S. Pearson, Milford
Edward Buck, Millville
John Eves & Co., Millville
Valley Machine & Turning Co., Monongahela
J. Howard Ames, Morgantown
Wm. H. Albright, Mount Penn
Mountville Mfg. Co., Mountville
Jacob M. Ames, Neffsville
C. H. Felten, New Baltimore
Darlington & Hoffman, New Bloomfield
B. S. Struckman, New Buena Vista
Shenango Lumber Co., New Castle
H. A. Buffenmyer, New Holland
Graff & Weaver, New Holland
Wm. Huntley, New Milford
C. H. Mathews, Newportville
Clarence Randall, Newtown
McGowan & Heuscher, Newtown
Horace Ervien, Ogontz
Harry Williams & Son, Ogontz
Eagle Spoke Works, Oil City
Kramer Wagon Co., Oil City
J. W. Connor, Orangeville
S. B. Wise Sons, Orrstown
Johnson Carriage Co., Oxford
Wilson Bros., Oxford
Martz & Fisher, Paxinos
J. G. Moyer & Sons Co., Perkasie
Max M. Betz & Son, 1041 Frankford Ave., Philadelphia
Bloch Go-Cart Co., 1136-48 N. American St., Philadelphia
The John Buckley Hub, Spoke & Wheel Co., 969-75 N. 2nd St., Philadelphia
J. Haynes Caffrey, 1712 Fairmount Ave., Philadelphia
Finnesey & Kobler, Inc., S. W. Cor. 26th & Parrish Sts., Philadelphia
Fulton-Walker Co., 1931 Filbert St., Philadelphia
Geo. W. Garrett & Sons, 39th & Lancaster Ave., Philadelphia
Hale and Kilburn Co., 18th St. & Lehigh Ave., Philadelphia
H. Kaiser & Co., Inc., 23rd & Race Sts., Philadelphia
Kessler Wagon Works, Inc., 857 E. Girard Ave., Philadelphia
Morris Truck & Wheel Co., 2016 S. Bancroft St., Philadelphia
Louis Oehme, 3045 Richmond St., Philadelphia
Petzelt & Keyser, N. E. Cor. 24th & Locust, Philadelphia
Pennsylvania R. R. (West Phila. Shops), Philadelphia
Rech-Marbaker Co., Eight St. & Girard Ave., Philadelphia
Rodenhausen's Excelsior Wagon Wks., 1437 Hutchinson St., Philadelphia
Frank Schanz, 408 N. Randolph St., Philadelphia
The Schwarz Wheel Co., Margaret St., & P. R. R., Philadelphia
Southwork Truck Co., 911-913 Ellsworth, Philadelphia
Sowney Bros., 1204 & 22 Frankford Ave., Philadelphia
Martin H. Walrath, Broad & Cambria, Philadelphia
Wm. Wenkenbach's Sons, 1310 Germantown Ave., Philadelphia
C. F. Buffington & Bros., Pillow
Jno. Deisenroth, 48 8th St., Pittsburgh
Doehle Wagon Co., 1055 Ohio St., Pittsburgh
Eagle Transfer Co., 101 Galveston Ave., Pittsburgh
Geo. J. Eisenhauer, 220 Brighton Road, Pittsburgh
H. J. Evans, 314-315 E. Reliance St., Pittsburgh
Frazier & Foltz, 2614 Smallman St., Pittsburgh
L. Glesenkamp Sons & Co., 320 Penn. Ave., Pittsburgh
R. J. Hayden, 4110 Liberty Ave., Pittsburgh
Wm. L. Heusel Wagon Co., 1st & Middle St, N. S., Pittsburgh
W. J. Hittner, 3402 Penn. Ave., Pittsburgh
Jno. H. Huy's Sons, Basin & Welsler Sts., Ewalt Station, Pittsburgh
Lewis Kauffman, 1206 East St., Pittsburgh
Kholos Wagon Co., 2213 Forbes St., Pittsburgh
H. Lange Wagon Co., 504 Second Ave. & S. St. Clair St., Pittsburgh
W. H. Leonhard & Son, 218 43rd St., Pittsburgh
H. Linde, So. 24th & Sidney, Pittsburgh
McClinton & Co., 309 Sandusky St., Pittsburgh
Metz & Miller, 813 Penn. Ave., Pittsburgh
Monongahela River Consolidated Coal & Coke Co., No. 8 Market St., Pittsburgh
Penn. Wheelbarrow Co., 4741 Kansas St., Pittsburgh
John Sauter, 414 Duquesne Way, Pittsburgh
G. A. Schnabel & Sons, 3069 Penn. Ave., Pittsburgh
Frank Sismour, 884 Main St., Pittsburgh
E. J. Thompson Co., Louisa St., Pittsburgh
H. R. Walter Lumber Co., Fayette & Manhattan Ave., Pittsburgh
J. G. Weir & Son, 1325 Liberty St., Pittsburgh
C. West & Co., 420 Duquesne Way, Pittsburgh
Wilkinsburg Carriage Works, 500 Penn Ave., Wilkinsburg, Pittsburgh
F. F. Childs, Pittsfield
H. N. Tritmyer, Pleasant Gap
H. W. Millard, Pomeroy
Pennsylvania R. R. Co., Pottsville
P. McKean Harl & Son, Lindsay Sta., Punxsutawney
Punxsutawney Fdy. & Mach. Co., Punxsutawney
Anchor Bending Works, Reading
Biehl's Carriage & Wagon Works, Reading
Keystone Vehicle Co., Reading
The S. G. V. Co., Reading
Wetherhold & Bros., Reading
Harvey S. Smith, Rebuck
D. J. Rumbel, Red Hill
Alvin Fauth, Red Lion
Noah C. Stabley, Red Lion
J. & H. C. Dieble, Reynoldsville.
Schrock Bros., Rockwood
Levi Hackerty, Rohrerstown
L. D. Fields, Roxbury
G. W. Huber, Rural Valley
McKelvey & Peters, Rural Valley
E. C. Beckley, Saint Clairsville
John Benore, Scranton
Blume Wagon Works, Scranton
A. R. Gould & Sons, Scranton
Mason & Snowdon Lbr. Co., Scranton
Steup Bros., Sewickley
Frank K. Morgan, Shamokin
Shamokin Wagon Works, Shamokin
J. M. Hoagland & Co., Sharon
E. M. Seyfert, Shartlesville

VEHICLES AND VEHICLE PARTS—Continued.

W. E. Sell, Shelocta
The Parker Mfg. Co., Souderton
L. Hammond, Spangler
The Graves & Eighmy Co., Springboro
Kramer & Son, Springboro
Ephraim Fluck, Springtown
Albert Miller & Co., Springtown
A. D. Shollenberger, Steinsville
F. B. Hess, Stockertown
Levi Raezer, Talmage
Christ & Becker, Tamaqua
Eagle Carriage Works, Tamaqua
The Tarentum Lbr. Co., Tarentum
Martin Hub Works, Tidioute
J. C. Scowden, Tionesta
Titusville Handle Co., Titusville
J. F. Cupp, Trout Run
Fred Caflisch, Union City
The Star Handle Co., Union City
J. M. Howard & Son, Uniontown
Thos. Matthews, Uniontown
G. W. Baum, Urban
J. M. Davis, Walnut Bottom
Samuel Peterson, Warren
John S. Pross, Warrington
Hoopes Bro. & Darlington, Inc., West Chester
Jacobs & Colley, Kingston, Wilkes-Barre
Frank L. Underwood, Luzerne, Wilkes-Barre
Wilkinsburg Carriage Works, 500 Penn. Ave., Pittsburgh, Wilkinsburg Br. P. O.
Loyalsock Planing Mill Co., Williamsport
J. L. Rush & Son, Willow Grove
Willow Grove Bending Co., Willow Grove
J. R. Barnhart, Worthington
A. D. Benton, Worthington
John F. Stephens, Woodbine R. D.
Werner & Lesher, Yeagertown
W. A. Eberly Wheel Works, York
Eureka Bending & Wheel Works, York
A. B. Farquhar Co., York
Hoover Wagon Co., York
The Martin Carriage Works, York
Ness Bros. & Co., York
Pullman Motor Car Co., York
Ervin Smith & Co., York
York Carriage Co., York
York Wagon Gear Co., York

WEIGHING APPARATUS.

Penn. R. R. Car Shops, Altoona
Penn. R. R. Co. (Juniata Shops), Altoona
Louis Kirchgraber, 613-15 Cherry St., Philadelphia
The Standard Scale & Supply Co., 243 Water St., Pittsburgh

WHIPS, CANES, AND UMBRELLA STICKS.

Chicora Whip Co., Ltd., Chicora
T. H. Gilpin, Greentown
Laanna Mfg. Co., Laanna
Wm. G. Bayha, 333-35 N. Fourth St., Philadelphia
James S. Caterson, 1136 Catherine St., Philadelphia
M. Horwitz, 305 Montrose St., Philadelphia
The Harvey V. Watt Co., 1804-26 E. Venango St., Philadelphia
L. Schneider Co., 4701 Worth St., Frankford
L. Silverstone & Co., 1126 N. Orianna St., Philadelphia
Geo. H. Lancaster, South Sterling
Wells Whip Co., Wellsville

WOODENWARE AND NOVELTIES.

Keystone Mfg. Co., Albion
Allentown Reed Harness & Mill Supply Co., Allentown
The Belmer Mfg. Co., Canton
The H. Sheldon Mfg. Co., Canton
Catawissa Specialty & Mfg. Co., Catawissa
Clearfield Woodenware Co., Inc., Clearfield
Corry Pail Co., Corry
F. E. Westley, Corry
East Greenville Mfg. Co., East Greenville
C. Prouty & Co., Eldred
Lovell Mfg. Co., Erie
Hanover Bending and Mfg. Co., Hanover
Laanna Mfg. Co., Laanna
E. H. Alpha, Lakeville
Oneida Community Ltd., Lititz
Glen Mawr Novelty Works, Mawrglen
Norris Pattern & Machine Co., Norristown
The Eclipse Co., North Girard
The Empire Co., North Girard
Penn Mfg. Co., North Girard
John C. Dettra & Co., Oaks
John P. Little Co., Pitcure Rocks
Nathan Cohen, 1126 N. Orianna St., Philadelphia
John Grass Wood Turning Co., 222 Vine St., Philadelphia
J. T. Hammond & Sons, Inc., 4534 Hedge St., Frankford, Philadelphia
Kassell & Co., 309 Montrose St., Philadelphia
John Klett, 1305 N. 27th St., Philadelphia
Thomas Ott & Co., 1124 Washington Ave., Philadelphia
L. Silverstone & Co., 1126 N. Orianna, Philadelphia
Geo. H. Lancaster, South Sterling
W. S. Wilcox, Turnersville, Jamestown P. O.
Blasdell Novelty Mfg. Co., Towanda
Patterson Bros. Co., Wellsboro
H. W. White, Whites Valley
F. B. Sherman, Williamsburg
W. John Stevens, Inc., Wyncote
Keystone Farm Machine Co., York

MISCELLANEOUS.

Pennsylvania Match Co., Bellefonte, Matches
Fred Fear Match Co., Bloomsburg, Matches
Coraopolis Mfg. Co., Coraopolis, Signs and Supplies
Penna. Hub & Veneer Co., Laquin, Brewers' Chips
Bernard McCurdy, Philadelphia, Flag and Tent Poles
Heilprin Mfg. Co., Philadelphia, Firearms
John Grass Wood Turning Co., Philadelphia, Bungs and Faucets
A. H. Fox Gun Co., Philadelphia, Firearms
Geo. H. Lancaster, South Sterling, Flag Poles and Staffs
F. B. Sherman, Williamsburg, Firearms

APPENDIX

ROUGH FOREST PRODUCTS.

It was pointed out on a preceding page that this study does not include the rough lumber produced by the Pennsylvania sawmills, nor the State's output of shingles, lath, cooperage, wood distillation, veneer, pulpwood, etc. The Bureau of the Census, co-operating with the Forest Service, yearly collects statistics for these commodities and in order to make this report complete in all phases of wood consumption, the census figures have been copied from the latest bulletins, 1911-12, in so far as they relate to Pennsylvania, and are presented in tabular form in the following paragraphs.

LUMBER.

In the production of chestnut lumber, Pennsylvania is second among the states, and third in the cut of hemlock, maple, and beech. The following table shows 22 woods cut in the State in 1912, arranged according to quantity, together with the average price per M feet at the mill and the total cost.

Table a.—Production of Rough Lumber.

Kind of Wood.	Quantity cut—Ft. b. m.	Average price per 1,000 ft.*	Total price.
Hemlock,	386,188,000	$15 41	$5,951,157
Oak,	209,473,000	19 52	4,088,913
Chestnut,	93,294,000	16 29	1,519,759
Maple,	81,617,000	16 19	1,321,379
White pine,	71,870,000	21 33	1,532,987
Beech,	49,686,000	12 64	628,031
Yellow pine,	21,647,000	13 87	300,244
Birch,	17,666,000	16 72	295,376
Yellow poplar,	14,413,000	22 75	327,896
Basswood,	10,925,000	18 67	203,970
Ash,	10,336,000	20 55	201,924
Hickory,	9,826,000	21 86	225,945
Elm,	2,994,000	16 67	49,910
Walnut,	2,268,000	21 47	48,694
Red gum,	1,454,000	12 47	18,131
Cedar,	892,000	14 40	12,845
Sycamore,	575,000	13 87	7,975
Spruce,	342,000	17 30	5 917
Balsam fir,	141,000	13 42	1,892
Tupelo,	100,000	13 90	1,390
Larch,	76,000	13 29	1,010
Cottonwood,	46,000	18 12	834
All others,	6,351,000	18 50	117,494
Total,	992,180,000	$17 00	$16,863,673

*Prices supplied from information in files of the Forest Service for prices f. o. b. mill.

LATHS.

Many of the plastering laths produced in Pennsylvania are produced from sawmill waste. Large quantities are also manufactured by portable lath mills that follow the sawmill onto cut-over tracts and clear up the remaining small softwood and the soft hardwood trees, as well as utilize the cutoffs, crooked logs, tops, and other material the lumbermen left in the woods. Hemlock and white pine are the principal lath woods in Pennsylvania, although spruce, yellow poplar, cucumber, and aspen were also reported.

SHINGLES.

Chestnut, because it is a durable wood outside and cheap, is the principal shingle material in Pennsylvania. White pine, hemlock, and a few hardwoods in small amounts were the other woods to contribute to the output. In the production of shingles Pennsylvania is not one of the principal states, but compared with the quantity of wood used by the various wood-using industries of the State and especially with the home-grown material reported, it is of considerable importance. Shingles made in Pennsylvania are both split and sawed, the sawed shingle is more salable and therefore, the kind generally manufactured.

Table b.—Production of Laths and Shingles.

Products.	Quantity.	Equivalent total feet b. m.
Laths,	78,758,000	15,752,000
Shingles,	26,957,000	2,696,000

COOPERAGE.

Table "c" reports the quantity and cost of material used in Pennsylvania for the manufacture of barrel stock, staves, and heading. Raw material for both stave and heading is usually purchased in the form of bolts but considerable sawmill waste is saved by being converted into these products. The prices given were not taken from the Census bulletin as they are not comprised in these statistics. Information concerning them was collected from cooperage plants by agents when in the field in connection with the wood-using industry investigation, and an average made of them and applied to the Census figures.

The manufacture of cooperage is an industry which rightfully comes within the scope of the wood-using industry study because both staves and heading are but knocked-down barrels and should be included the same as box shooks or other manufactured material which needs only to be assembled to be finished. However, owing to the fact that one Bureau of the Federal Government gathers these statistics, the Forest Service did not deem it expedient to seek similar information from the cooperage plants twice in the same year. Had the cooperage data been included in the foregoing report, this industry, according to quantity consumed, would have stood fourth in the list of over 51 industries in Table 3. Thirteen woods are demanded each year for staves and heading. They are shown in the order of amounts as follows:

Table c.—Production of Cooperage Stock.

Kind of Wood.	Number of staves.	Sets of heading.	Equivalent total quantity raw material required ft. b. m.	Average cost per 1,000 ft., bolt form.	Total cost.
Beech,	78,588,000	2,347,000	85,082,700	$7 00	$595,579
Chestnut,	46,186,000	3,545,000	71,079,252	6 00	426,476
Maple,	22,108,000	1,715,000	34,199,916	7 00	239,399
Birch,	10,367,000	231,000	10,458,756	6 50	67,982
Pine,	7,957,000	1,773,000	23,556,780	7 00	164,897
Oak,	1,972,000	....	1,561,824	6 00	9,371
Red gum,	414,000	77,000	1,077,252	7 75	8,349
Spruce,	200,000	....	158,400	6 50	1,030
Ash,	146,000	7,000	183,756	6 50	1,194
Elm,	105,000	3,000	112,356	7 00	786
Yellow poplar,	47,000	55,000	572,484	6 50	3,721
Basswood,	37,000	196,000	1,936,776	7 00	13,557
All others,	437,000	....	346,104	6 15	2,129
Total,	168,564,000	9,949,000	230,326,356	$6 66	$1,534,470

PULPWOOD.

The quantity of wood consumed for making paper pulp in Pennsylvania, according to the 1911 Census figures, amounts to over 315,000 cords. It is procured in bolt form and is equivalent to more than 158,000,000 board measure feet that is annually taken from the forests of the State. Pennsylvania is the fifth State in the consumption of wood pulp and stands next to Maine in using large quantities of mill and woods waste in this line of manufacture.

Table d.—Pulpwood Consumption.

Kind of Wood.	Cords.	Equivalent total ft. b. m.
Spruce,	56,243	28,121.500
Pine,	51,265	25,632,500
Beech,	44,320	22,160,000
Yellow poplar,	35,120	17,560,000
Hemlock,	33,181	16,590,500
Maple,	30,874	15,437,000
All others,	10,295	5.147.500
Slab wood and other mill waste,	54,384	27,192,000
Total,	315,682	157,841,000

HARDWOOD DISTILLATION.

Beech, birch, and maple are the principal woods consumed in hardwood distillation. They have been separated in the following table merely to emphasize the kinds used and the quantities are not representative of the actual results but were arbitrarily divided in equal amounts for the want of more definite information. Besides the above named woods, oaks, hickory, chestnut, elm, and ashes were also consumed but in small quantities only. Pennsylvania hardwood distillation plants generally employ the destructive process. Charcoal, crude wood alcohol, and gray acetate are the principal products.

Table e.—Hardwood Distillation.

Kind of Wood.	Cords.	Equivalent total ft. b. m.
Beech,	121,513	60,756,500
Birch,	121,513	60,756,500
Maple,	121,513	60,756,500
Total,	364,539	182,269,500

VENEER.

Over 2,500,000 feet of logs in Pennsylvania were converted into veneer in 1911. These are not necessarily cut from the forests of the State as veneer logs are sought after over a wide territory and are imported from foreign countries and manufactured into veneer by mills in easy reach of important markets. In Pennsylvania maple was the principal wood consumed, followed by beech, yellow poplar, basswood, oak, birch, and cherry, in the order named. Spanish cedar was the only foreign wood.

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BULLETIN No. 10 JUNE, 1914

Commonwealth of Pennsylvania

DEPARTMENT OF FORESTRY

(Issued by Direction of the Commissioner of Forestry)

The Strumella Disease of Oak and Chestnut Trees

BY

F. D. HEALD

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Agents, Investigations in Forest Pathology
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THE STRUMELLA DISEASE OF OAK AND CHESTNUT TREES.[1]

BY

F. D. HEALD and R. A. STUDHALTER, *Agents,*

Investigations in Forest Pathology, Bureau of Plant Industry.

INTRODUCTION.

The study of chestnut tree blight in Pennsylvania has brought to light a serious disease of the chestnut due to an entirely different organism. The trouble is not confined to the chestnut but attacks various species of oaks. The disease is obscure in its early stages and in some of its more advanced phases, which probably accounts for the fact that it has not been generally observed by foresters. Our recent studies reported by the senior author[2] lead to the belief that it is a rather widespread disease and responsible for the death of many trees, both young and old.

What was probably the same trouble was briefly described in 1899 by Dr. W. A. Buckhout[3], as causing the death of various species of oak trees, but no mention was made of the occurrence of the disease on chestnut trees. While he regarded the disease as of fungous origin, no definite determination of the causal organism was made. The correctness of our inference that he was dealing with the same trouble is based largely on the similar symptomology as may be noted by comparison of our description with the following quotation: "The black oak is particularly subject to a disease apparently of the same nature if not identical with *Nectria ditissima*, the canker of the apple tree. The early stages of the disease are obscure and inconspicuous, and one's attention is attracted only after serious injury has been done. Apparently the starting point is at the base of a small branch, causing the death and slow decay of surrounding bark and wood. Both continuation of decay and the effort of the trunk to repair the injury go on together, but it is generally a losing battle. The dead region spreads in spite of the efforts made to produce a callus, covering an enlarging elliptical area on which the little branch shoot appears in the middle as a sort of centre about which circle the lines representing the different stages in the process. As time proceeds, the rest of the trunk receives the normal additions of wood and bark, while the dead parts become more and more an element of weakness."

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[1] Published by permission of the Secretary of Agriculture.

[2] Heald, F. D. A little-known disease of chestnut and oak trees. Phytopathology 4: 49. 1914.

[3] Buckhout, W. A. The undesirability of red and black oak because of fungus disease. Report Penna. Station, 1899: 250-252.

Unfortunately no specimens of oak showing this disease are preserved in the State College collections, but the occurrence of the Strumella disease in the vicinity of State College at the present time lends added support to the descriptive evidence that Buckhout was certainly dealing with the trouble described in the following pages. It seems strange however, that a disease recognized fifteen years ago should continue its ravages and escape further study until the present time.

Although our knowledge concerning this disease is still very imperfect, sufficient data have been accumulated to justify us in presenting a short account. The main object at the present time is to call attention to the importance of the disease and describe its characters in sufficient detail to enable foresters and pathologists to recognize it.

SYMPTOMS AND EFFECTS.

There is a rather remarkable parallelism between this new disease and the well-known chestnut tree blight as far as general symptoms and effects are concerned.

Young infections of the Strumella disease on smooth-barked trunks can be easily recognized by the presence of yellowish or yellowish-brown patches, slightly raised, and standing out in marked contrast to the normal bark which is darker in color. The area invaded by the fungus may be fairly regular in outline, but it is very frequently irregular in outline, the latter showing what may be designated as the amoeboid type of infection (fig. 1). The most noticeable external difference between young lesions of the chestnut blight (Endothia), and those of the Strumella disease, is the presence in the latter of small black nodules, scattered over the surface of the yellowish area which marks the extent of the lesion. In young infections of the type described the dark nodules are either aborted or rudimentary fruiting pustules No fertile pustules have ever been found in these young infections, but spore production occurs in the later stages of the disease. The yellowish-brown color is caused by the whitish, or very pale buff-colored vegetative body, or mycelium, of the causal fungus, which is covered only by the thin external layer of cork cells. If some of this cork layer is removed from the advancing edge of the lesion, the mycelium exposed will show its pure white color, but in more central and older parts the mycelium has changed to a pale buff color. In general it is lighter in color than the mycelium of the chestnut blight fungus, and definite "fans" characteristic of the latter are not noticeable. Lesions of this type have been found on shoots up to 4 or 5 inches in diameter, and varying from minute incipient infections to those completely encircling the trunk. The young infections are much more obscure on older or rough-barked trunks, but there is generally sufficient difference in color to indicate the extent of infection.

Two forms of the disease may be recognized with further development of the trouble: first, the *canker type,* in which the progress of the fungus is slow with a more or less pronounced formation of callus at the advancing edge of the lesion; second, the *diffuse type,* in which the fungus spreads more rapidly, killing the tissues so quickly that the formation of callus is not possible. Apparently it was only the conspicuous *canker type* that was observed and described by Buckhout.

In the well-defined canker there may be more or less zonal growth (fig. 7), as the result of the repeated formation of callous tissue at the advancing edge, but it is the exception for the callus to check the advance of the fungus. The lesion is generally extended more rapidly lengthwise of the trunk than transversely, thus giving rise to cankers of somewhat elliptical outline (figs. 2 and 3). Cankers five feet or more in length have been observed on trunks of chestnut trees 6-8 inches in diameter that had not yet been girdled. In old cankers there is likely to be more or less destruction of tissue at the center, so as to leave a somewhat open wound exposing the decaying wood (figs. 3 and 5). Old cankers are likely also to show the work of woodpeckers and insect larvæ.

When a well-defined canker is not produced the extent of the lesion may be indicated by an elliptical discolored area which is generally somewhat depressed. Even when the bark of this area is not destroyed it is rougher than surrounding portions due to more or less shrinking and cracking. In all cankers the characteristic black nodules may be noted on those portions on which the bark has remained intact.

In some infections there is a pronounced enlargement or hypertrophy of the entire invaded area (fig. 6), instead of atrophy or lessening of growth. In the open cankers there may be more or less enlargement or distortion of the trunk (figs. 3, 5 and 7), due to the stimulating effect of the parasite. Such effects appear to be more frequent on the oaks than on the chestnut.

The disease is least evident in its *diffuse form*. In this type there is an absence of well-defined cankers and the fungus appears to spread so rapidly that little or no callus is developed. In such cases the young tree is killed before time has been given for the development of a canker. This points to the fact that the larger trees showing well-defined cankers represent the few individuals that have offered the most resistance to the attacks of the parasite. The diffuse type of the disease has not yet been found on anything but young trees up to 3-4 inches in diameter. It should not be understood that there are two entirely distinct types of the disease, for there are all gradations between the pronounced canker types and the diffuse types; in the intermediate types the lesion may be marked by a more or less concentric zonation (figs. 2, 4 and 7), while in the extreme diffuse type no zonation is evident (fig. 8).

The disease appears to start in a branch axil. In all young infections or old cankers this relation is an invariable rule, and in lesions of any age the dead stub of a branch marks the center of the infection (fig. 7). After the branch has been killed the fungus grows more rapidly through its tissues, and soon produces the characteristic fruiting pustules over its surface in the form of dark brown, powdery, and erumpent nodules 1-3 mm. ($\frac{1}{25}$-$\frac{1}{8}$ inch) in diameter (fig. 8).

The production of sprouts or "suckers" just below a lesion is one of the marked characteristics in either the canker or semi-diffuse forms of the disease (figs. 11 and 12). This production of vigorous sprouts occurs as soon as the trunk has been girdled, and they may be few in number or sufficiently numerous to make a conspicuous clump.

The final result of the disease is the death of the tree, but in the extreme canker type there is a rather prolonged struggle. No cases have been observed where the advance of the parasite has been permanently checked. It is apparently the diffuse type of the disease that is exacting the larger toll, if we may judge from observations in certain localities where the disease is especially prevalent. The disease is especially serious since there is a marked tendency to the production of body or trunk cankers only. They may occur at any point from the ground up but they appear to be more common in the lower portions of the trunk. As soon as girdling has been completed the parts beyond the canker must succumb, but even before such a fatal termination, the trunk may be so weakened by the inroads of the fungus as to be unable to withstand the force of strong winds. Many fallen oaks which have been broken at a lesion are silent witnesses of the destructiveness of this trouble (fig. 12). Unlike the chestnut bark fungus, the organism in question grows equally well in both bark and wood. It is this disintegration of the wood by this parasite and not by secondary decays that causes the pronounced weakening of the trunk in the region of a canker. The extent to which the fungus invades the wood even in the canker type is shown in Fig. 14, the light area being the portion infected. In Fig. 13 the only normal wood remaining shows a light color also.

THE CAUSAL ORGANISM.

A single species of fungus is invariably associated with this disease. It has repeatedly been isolated from all of the different types of the disease on a variety of hosts.[1] The fungus grows well in ordinary culture media, but 3% dextrose agar has been used in making most of the isolations. Tissue transfers made by planting small fragments of diseased bark or affected wood in agar plates give pure cultures in the majority of cases. Typical isolation plates are shown in Figs. 15 and 16. The fungus produces a cottony aerial mycelium and this turns to a dirty gray after one to three weeks. The under side of the colony shows a dark brown or black coloration which first becomes noticeable at the center and gradually spreads towards the periphery of the colony. Different strains show great variation in the amount and intensity of darkening (fig. 17). No spore formation has been observed in any cultures.

The fungus in question, *Strumella coryneoidea* Sacc. & Wint., is not a new one, but is an old species which has not previously been accused of being a parasite. It was first collected at Perryville, Mo., in 1883, by C. H. Demetrio and described by Saccardo and Winter.[2] The fungus has also been collected at London, Ontario, on oak bark by J. Dearness (No. 94, June, 1889). The two following collections referred to this species were apparently incorrectly determined:

1.—Flora of Washington. No. 307. Collected Jan. 28, 1894, on dead branches of *Rhus diversiloba* J. and G., by W. N. Suksdorf. Columbia River, W. Klickitat Co.

2.—Flora Ludoviciana. No. 1799. Collected Mar. 30, 1889, on young dead twigs of *Carya olivaeformis* by A. B. Langlois. St. Martinsville P. O., La.

A careful comparison of our specimens with those of Demetrio (Ellis and Everhart. North American Fungi, No. 1653), and Dearness (No. 94), has failed to reveal any morphological differences, so we feel justified in referring the parasite to the species originally described by Saccardo and Winter. The causal relation is based not only on the constant association of the fungus with the disease but also upon successful inoculations in the field. That *Strumella coryneoidea* was not connected with the disease by Dr. Buckhout[3] is evident from his statement that the disease is "apparently of the same nature if not identical with *Nectria ditissima,* the canker of the apple tree."

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[1] Many of the isolations were made by Mr. R. C. Walton, who was associated with the writers during the earlier work on this disease.

[2] Saccardo and Winter. Rabenhorstii Fungi europaei extraeuropaei. No. 2984. Hedwigia, 1883: 175-176. Ellis and Everhart. North Am. Fungi, No. 1653, June 1885.

The fruiting stage.—During the time previous to the girdling and consequent death of a branch or trunk, the fungus produces only mycelium and aborted or rudimentary fruiting pustules. As soon as the girdling has been completed, however, an abundance of fertile pustules appear in the form of brownish erumpent powdery cushions, the *sporodochia,* scattered either sparsely or abundantly over the surface of the invaded portions and also beyond the extent of the original lesion (figs. 8 and 18).

The sporodochia vary in size from 1-3 mm. in diameter (fig. 19), and each consists of a dense aggregate of fungous tissue which bursts through the external cork layer in the form of a rounded nodule which produces over its entire free surface a multitude of erect, branched, spore-bearing hyphæ or conidiophores. Spores are developed in profusion from the terminal portions of the brownish conidiophores (fig. 20), and either loose or attached, give the granular or powdery appearance to the fruiting pustules (figs. 8 and 18). The spores (fig. 21) are light or very dark brown, single-celled, vary from nearly globular to pear-shaped or irregular in form, and vary in size from 5.1—13x4—7.3 mikrons. No ascus stage has been found in the life cycle of this fungus, but the profusion of conidiospores would appear to offer an effective means of dissemination. As the accumulated spore mass is powdery when dry it seems probable that wind dissemination is one of the important means of spread of the fungus. The loose spores are undoubtedly washed down by rains. The latter statements are based however on observational evidence rather than on direct experimental evidence.

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[3] Loc. cit. p. 250.

HOST RELATIONS.

This disease must be viewed with some additional concern since it is not confining its attacks to a single species. As a disease of the chestnut it is much less virulent than the Endothia blight but it occurs on the chestnut beyond the present range of the chestnut bark disease. Various species of oaks are affected and in some localities the disease has made such headway as to cause some alarm. In the short experience with this disease up to date it has been found attacking the following species:

American chestnut, ...	*Castanea dentata* (Marsh.) Borkh.
Chestnut oak, ...	*Quercus Prinus* L.
Black oak, ...	“ *velutina* Lam.
Red oak, ...	“ *ruba* L.
Scarlet oak, ...	“ *coccinea* Muench.
White oak, ...	“ *alba* L.

The disease appears to be more severe on the red and black oaks, and also produces more pronounced cankers on these species. The most typical development of the disease upon oaks has been observed in fairly dense stands in which a single species predominates. The disease is more obscure on the white oak than on any other species of oaks. This is due to the very rough character of the normal bark, which may render inconspicuous lesions of some extent. The Strumella cankers on the chestnut (fig. 9) are rarely as conspicuous as those caused by Endothia. In some Strumella infections in this species the lesion may reach a considerable size without showing much discoloration or depression of the bark. There is but rarely any indication of concentric zonation in lesions on this species, while it may be recalled that this character is especially marked in the oak species. In old cankers in all species there is generally more or less corrosion at the center, so as to leave a rough, open wound. It seems probable that all species of oaks will be found susceptible to this disease.

GEOGRAPHICAL DISTRIBUTION.

The Strumella disease has been studied from specimens collected at widely separated points in Pennsylvania. The first specimens studied were collected in Somerset county in the southwestern part of the State. In this region the disease was prevalent on both chestnut and chestnut oak. A little later the trouble was found on chestnut oak in Mifflin county in the central part of the State. It is common on the red and black oaks, and occasional on the white oaks in the State forest in Huntingdon county. It has been observed in Elk county in the northwestern part of the State, where it is especially severe on the chestnut in a number of localities. Studies made in Carbon county in the eastern part of the State show that the trouble is fairly common. It has also been reported from Pike county. The known occurrence of the disease at localities in the southern, middle, northern and eastern portions of Pennsylvania suggest that a more detailed scouting of our forests will show a rather general distribution throughout the State.

The causal fungus, *Strumella coryneoidea,* has been collected in the fruiting stage on both chestnut and oak species in several of the localities studied. The specimens received from some of the localities represent only the canker type, probably due to the fact that only conspicuous examples of the trouble were observed by the collectors. In the localities worked in detail by the writers, the fruiting stage has always been found. In this connection reference may be made to the first collections of the fungus in Missouri, and its later collection from Ontario, Canada, as indicating a wide range. All of the evidence at present points to the parasite as a native of the northeastern portion of North America. If this supposition is correct, the disease is less likely to prove as virulent as though it were introduced from some foreign country. The behavior of the chestnut bark disease is prophetic of what might happen if the Strumella disease should be introduced into new localities.

The supposition concerning the wide distribution of the disease has been further substantiated by the collection of authentic specimens on both the black and white oak in Massachusetts by Mr. R. G. Pierce. It is hoped that this brief description will aid and stimulate further observations and study on this interesting tree disease, so that we may have more complete information as to its range and prevalence.

EXPLANATION OF PLATES.

All of the photographs used for illustrating this bulletin were made under the writers' supervision from specimens collected in Pennsylvania.

PLATE I.

Fig. 1.—A young Strumella infection of the "amoeboid" type on chestnut oak 3 inches in diameter. The minute black nodules scattered over the surface distinguish this superficially from a young chestnut blight lesion.

Fig. 2.—A semi-diffuse type of infection showing three distinct zones of growth, and the characteristic dark nodules scattered over the invaded area. The cut stub of a branch shows at the center, and its lighter peripheral portion indicates the depth to which the fungus had penetrated the wood.

PLATE II.

Fig. 3.—A well-defined canker on red oak 2.5 inches in diameter. The advance of the fungus was checked on the right by a marked formation of callus. In the central part the bark was completely destroyed so as to leave an open wound exposing the wood. (See also Fig. 13 for transverse section through this canker).

Fig. 4.—The same specimen shown in Fig. 3 viewed from the opposite surface. The zonal advance of the fungus may be noted. Only a narrow bridge of uninfected tissue remains. (See also Fig. 13).

PLATE III.

Fig. 5.—Canker on a black oak 3 inches in diameter showing considerable hypertrophy and also the destruction of tissue to form an open wound.

Fig. 6.—A young lesion on chestnut oak 1 inch in diameter showing hypertrophy, with characteristic longitudinal cracking of the bark. The fungus has completely encircled the trunk.

PLATE IV.

Fig. 7.—A canker on a scarlet oak 2.5 inches in diameter showing pronounced zonal growth and the stub of a branch at the center. (See Fig. 14 for transverse section through this canker).

Fig. 8.—Portion of a small black oak tree 1.5 inches in diameter killed by the diffuse type of the disease. The characteristic fruiting pustules, or sporodochia, are very numerous over the entire surface.

PLATE V.

Fig. 9.—Typical Strumella canker on a chestnut trunk 6 inches in diameter. Note that on this species the extent of the lesion is indistinct.

Fig. 10.—A body canker from a young white oak tree. The elliptical outline of the canker was especially noticeable in its earlier stages, and callus-zones mark its progress.

PLATE VI.

Fig. 11.—Portion of a small black oak tree killed by the Strumella disease. Vigorous sprouts or "suckers" were produced below the lesion which was of the semi-diffuse type. The center of the infection is marked by a short stub of a branch.

PLATE VII.

Fig. 12.—A black oak which has been broken by the wind at the lesion. The copious sprouting below the lesion is evident and the canker also shows the work of woodpeckers.

PLATE VIII.

Fig. 13.—Transverse section through the middle of the canker shown in Fig. 3. The light area on the left is the only normal tissue that remains.

Fig. 14.—Transverse section through the middle of the canker shown in Fig. 7. The lighter area above the organic center has been invaded by the fungus and the wood disintegrated. This affected wood is soft and punky.

PLATE IX.

Fig. 15.—An isolation culture of *Strumella coryneoidea* on 3% dextrose agar, made by tissue transfers. The small fragment of diseased tissue is still noticeable at the center of each colony.

Fig. 16.—An isolation culture of *Strumella coryneoidea* on 3% dextrose agar made by transferring marked colonies from poured plates.

PLATE X.

Fig. 17.—A series of cultures of Strumella on dextrose agar taken from the under surface to show the variation in the development of the black coloration characteristic of the species. Each culture represents a different strain.

PLATE XI.

Fig. 18.—A piece of bark slightly magnified to show the characteristic fruiting pustules, or sporodochia, in the form of dark brown, powdery, erumpent nodules.

Fig. 19.—Vertical section through a typical sporodochium. The dense aggregate of fungous tissue has broken through the periderm, and produced a superficial zone of branched conidiophores, in the terminal parts of which spores have been formed. Semi-diagramatic from a camera drawing. X-75.

PLATE XII.

Fig. 20.—A single branched conidiophore showing characteristic form and septation. The spores are loosely attached and easily separate from the conidiophores. X-800.

Fig. 21.—Terminal portion of a conidiophore showing the origin of spores. X-800.

Fig. 22.—Camera drawing of spores showing the variation in form. X-800.

PLATE I.

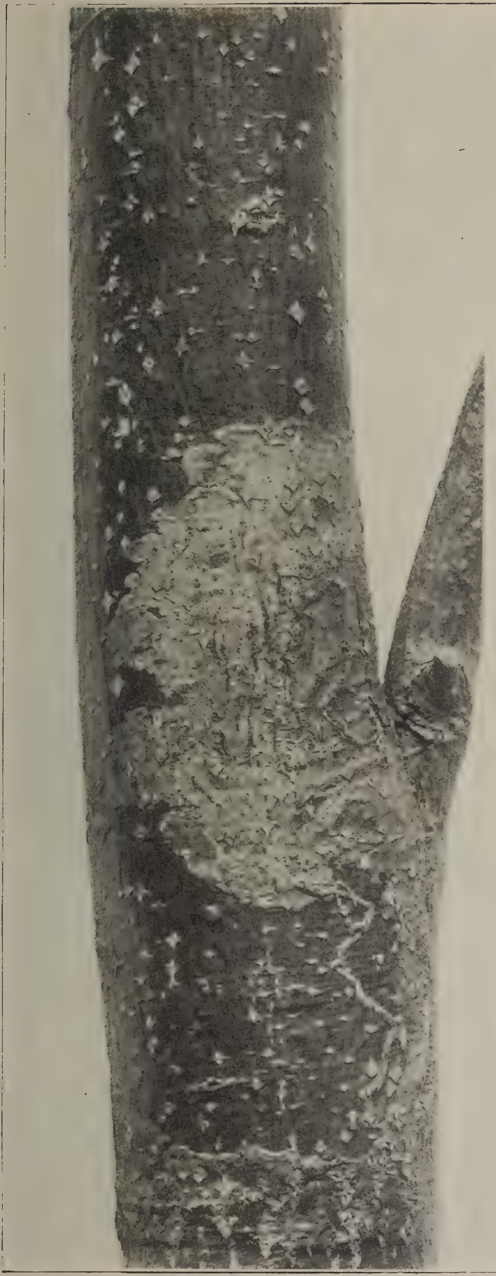


Fig. 1.

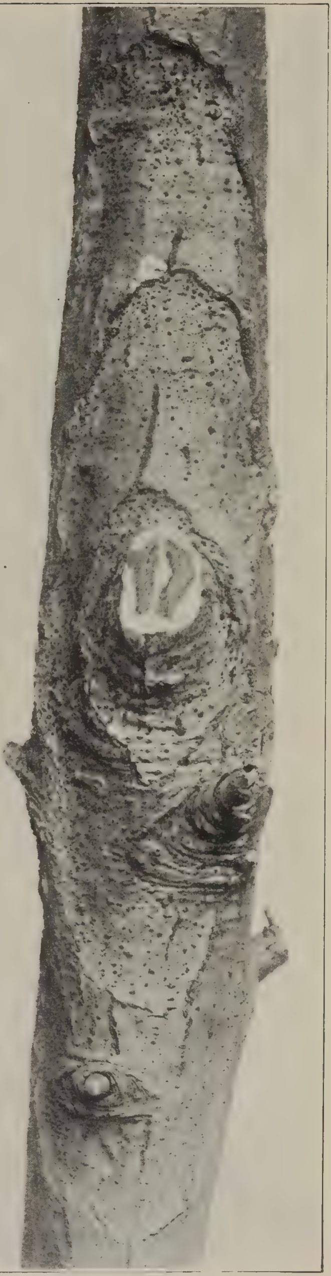


Fig. 2.

PLATE II.

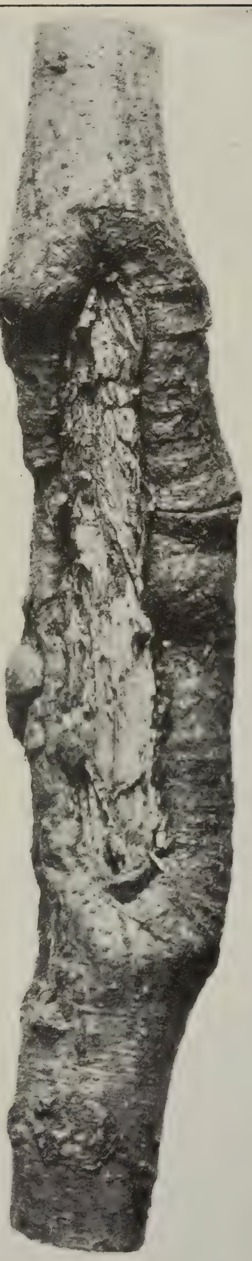


Fig. 3.

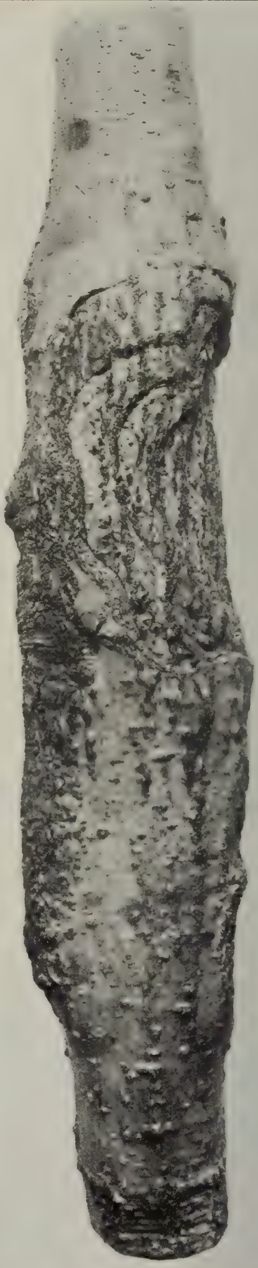


Fig. 4.

PLATE III.

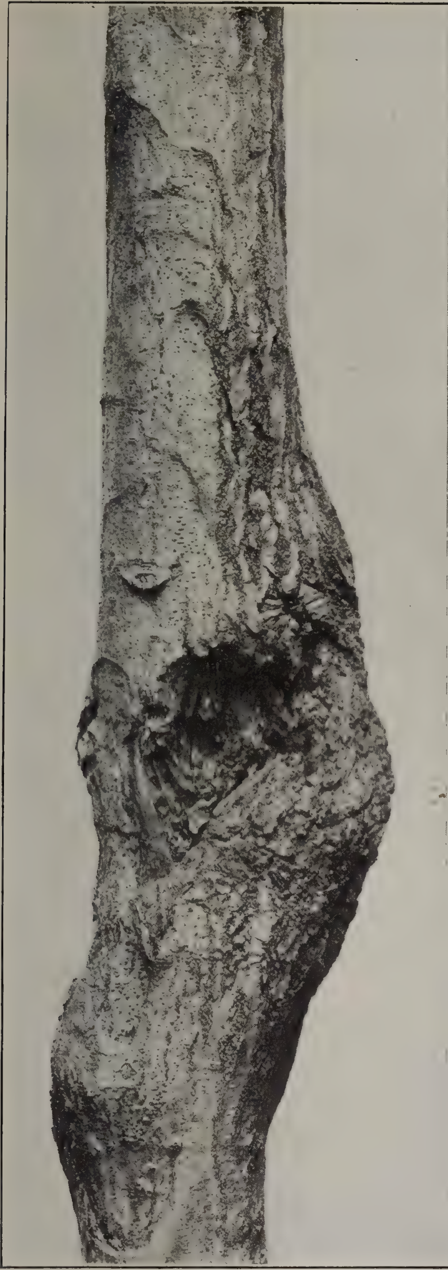


Fig. 5.

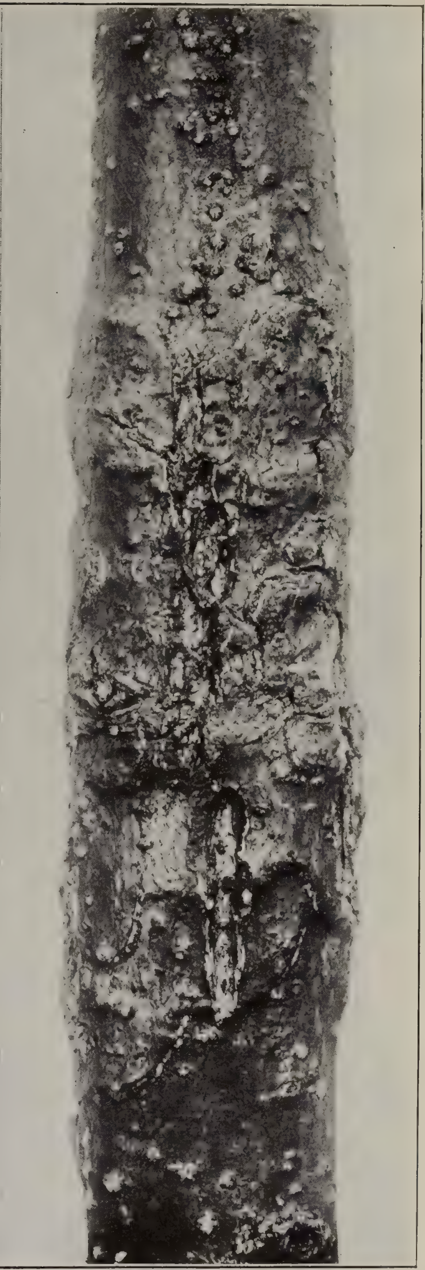


Fig. 6.

PLATE IV.

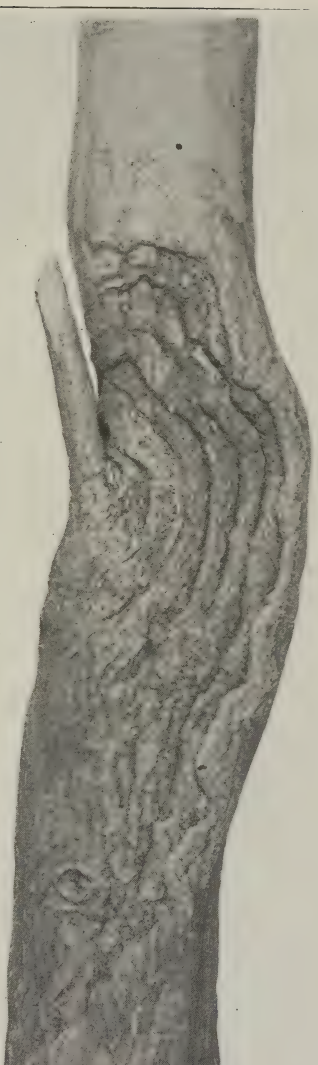


Fig. 7.

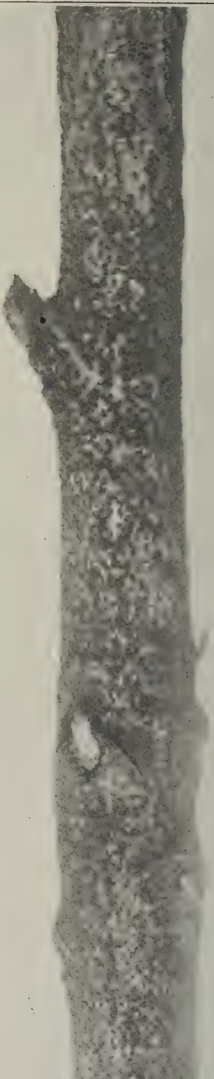


Fig. 8.

PLATE V.

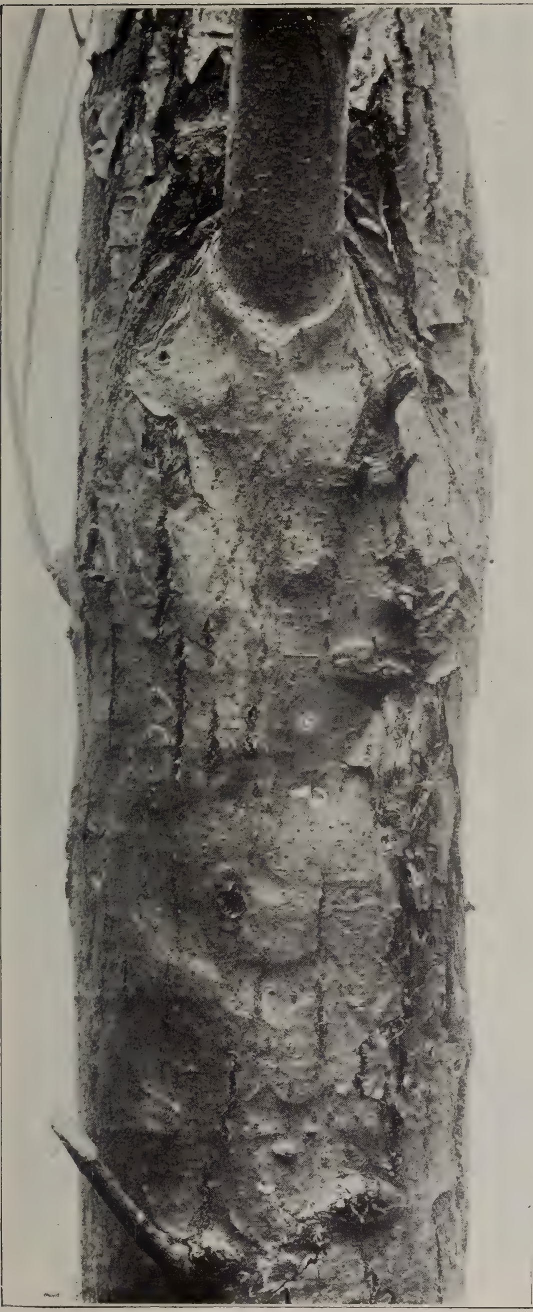
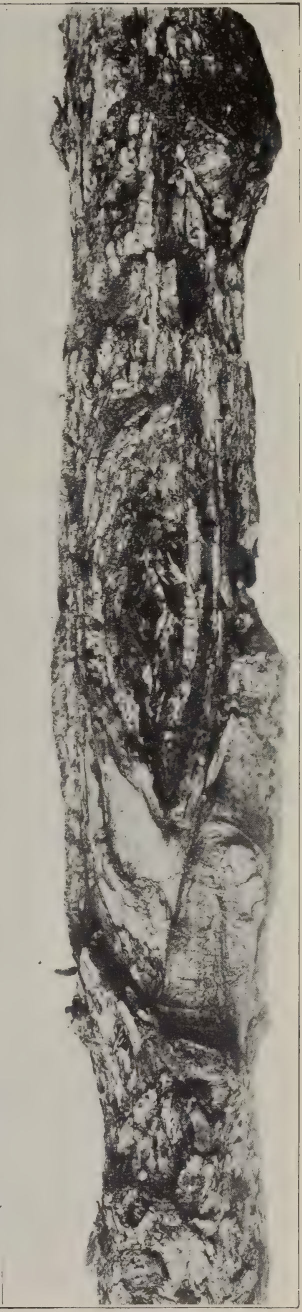


Fig. 9.



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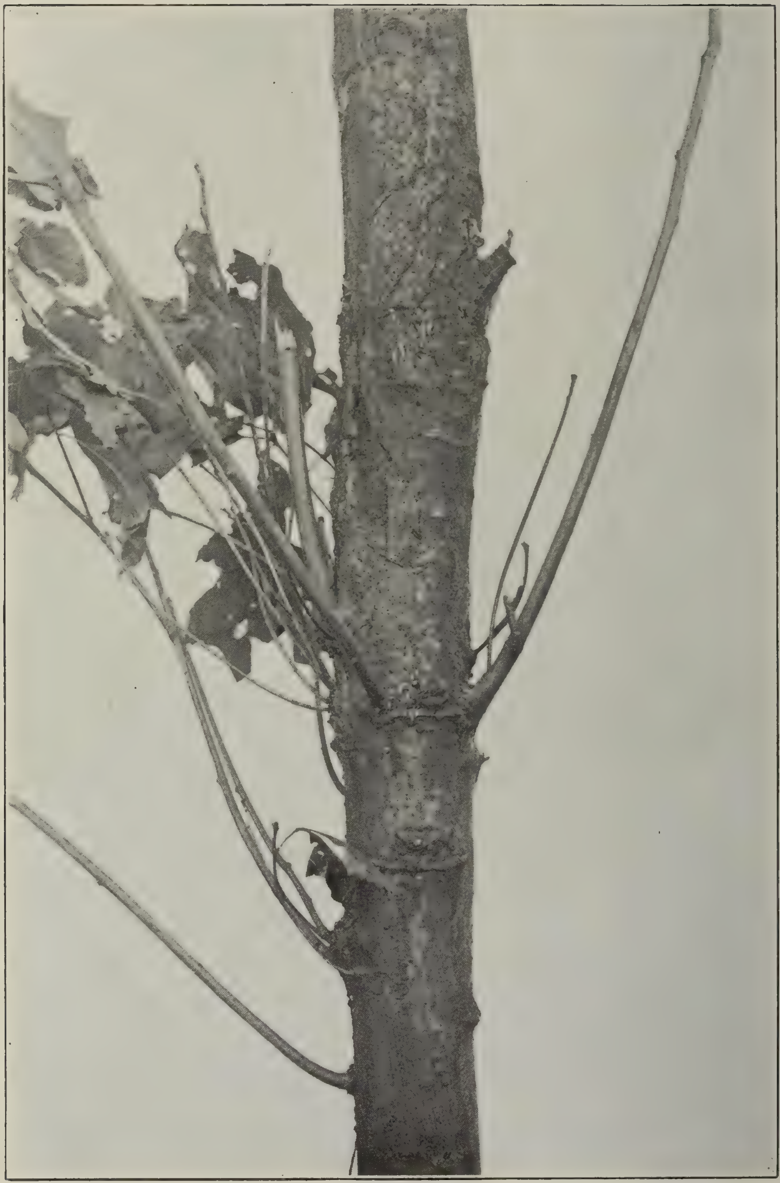

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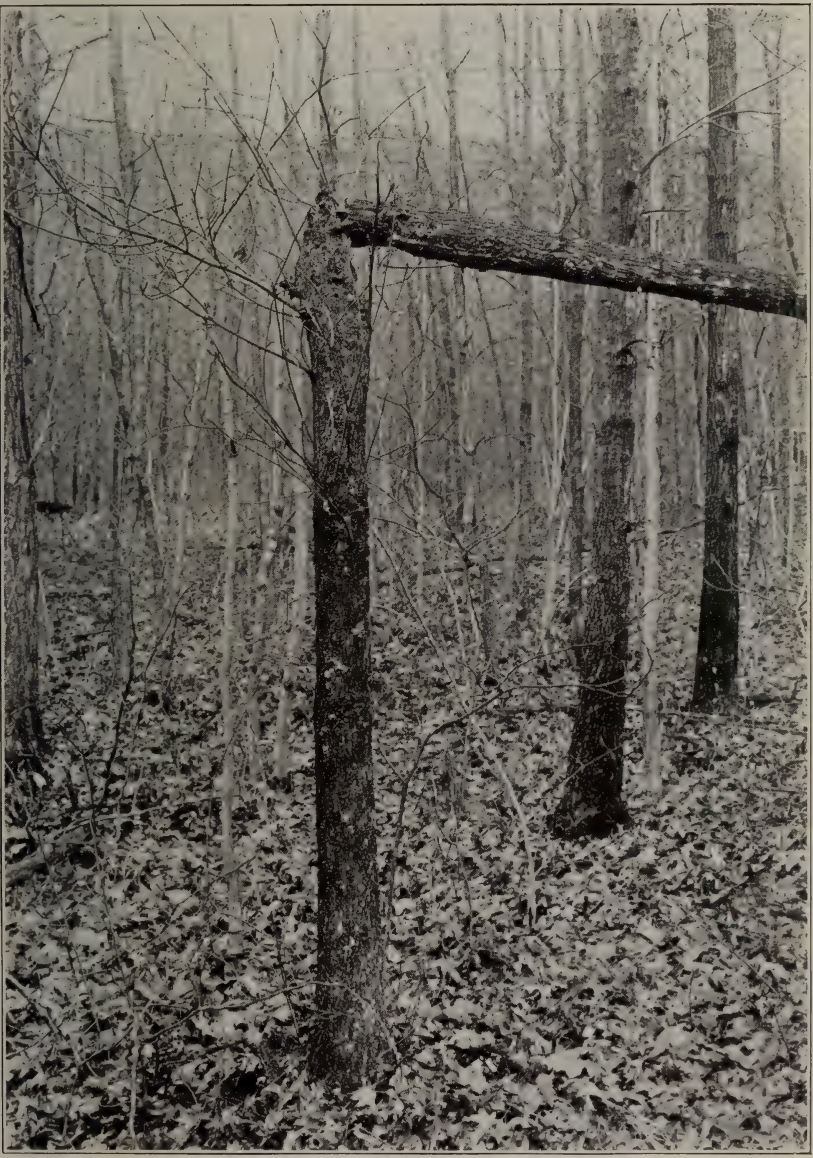

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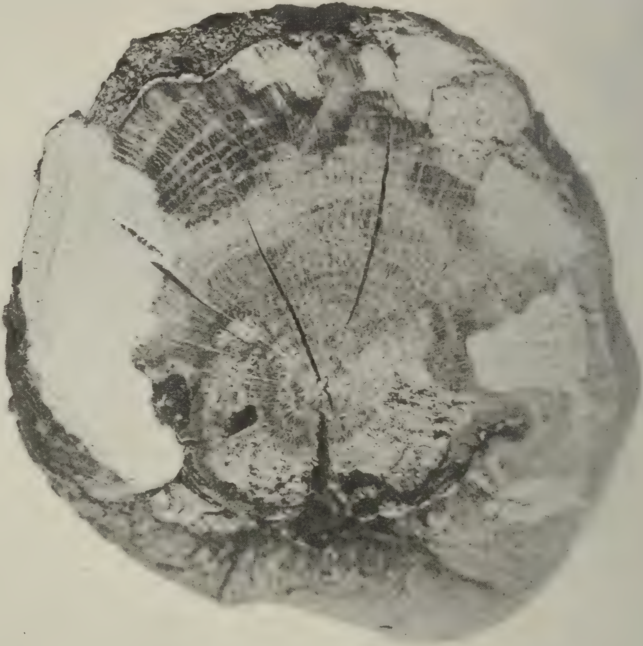

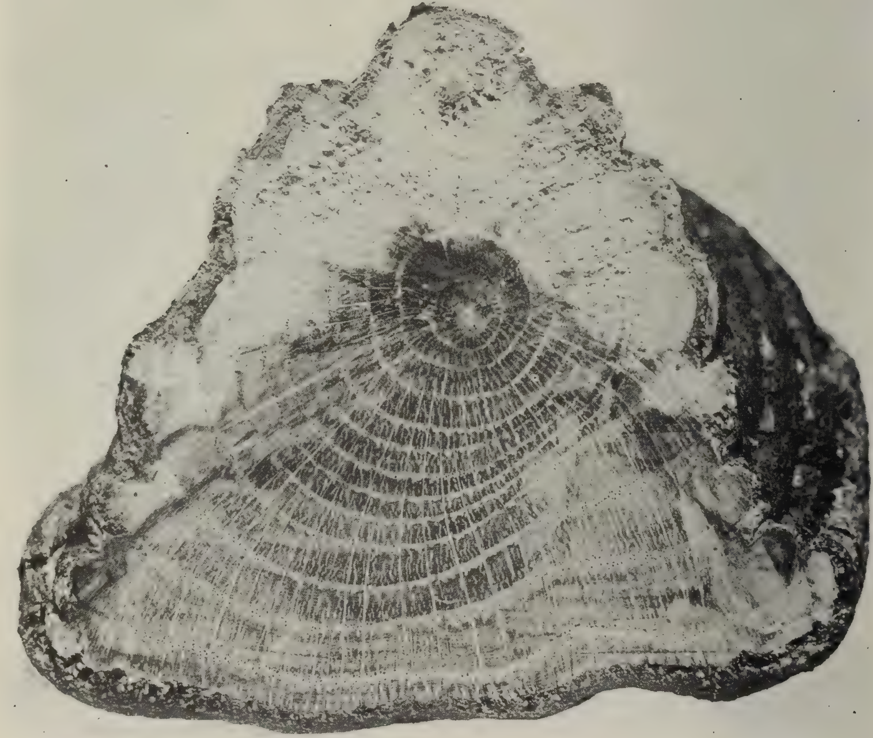

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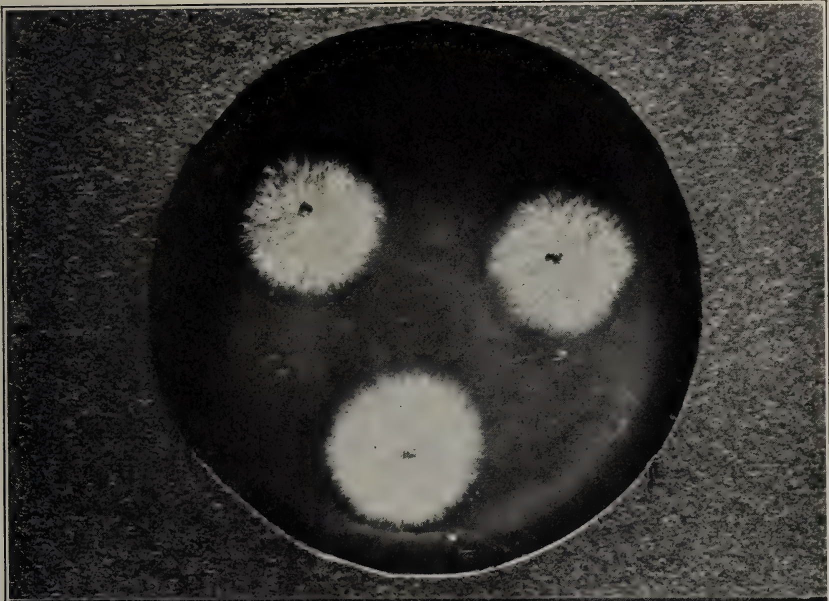

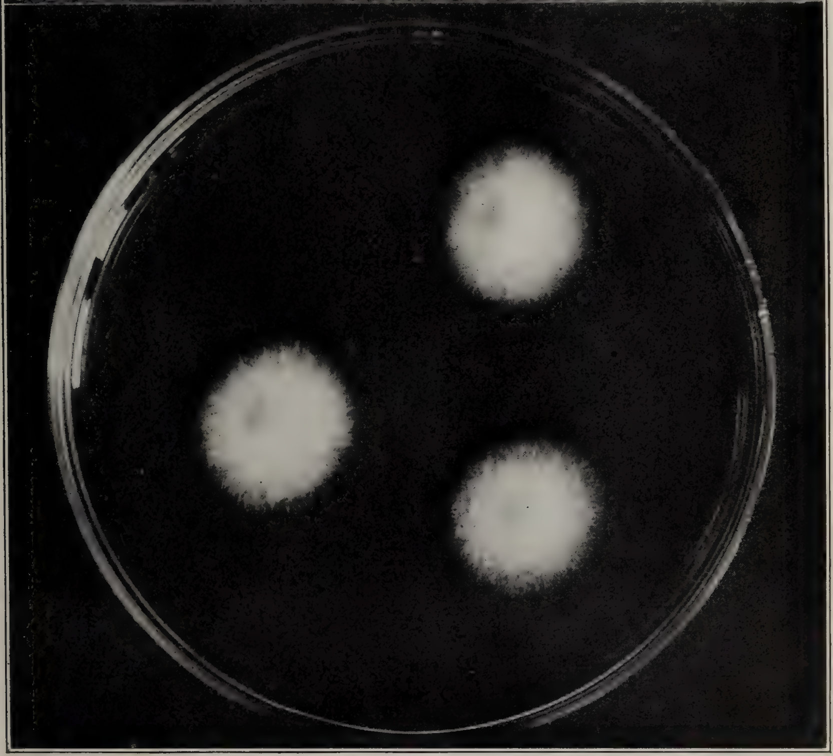

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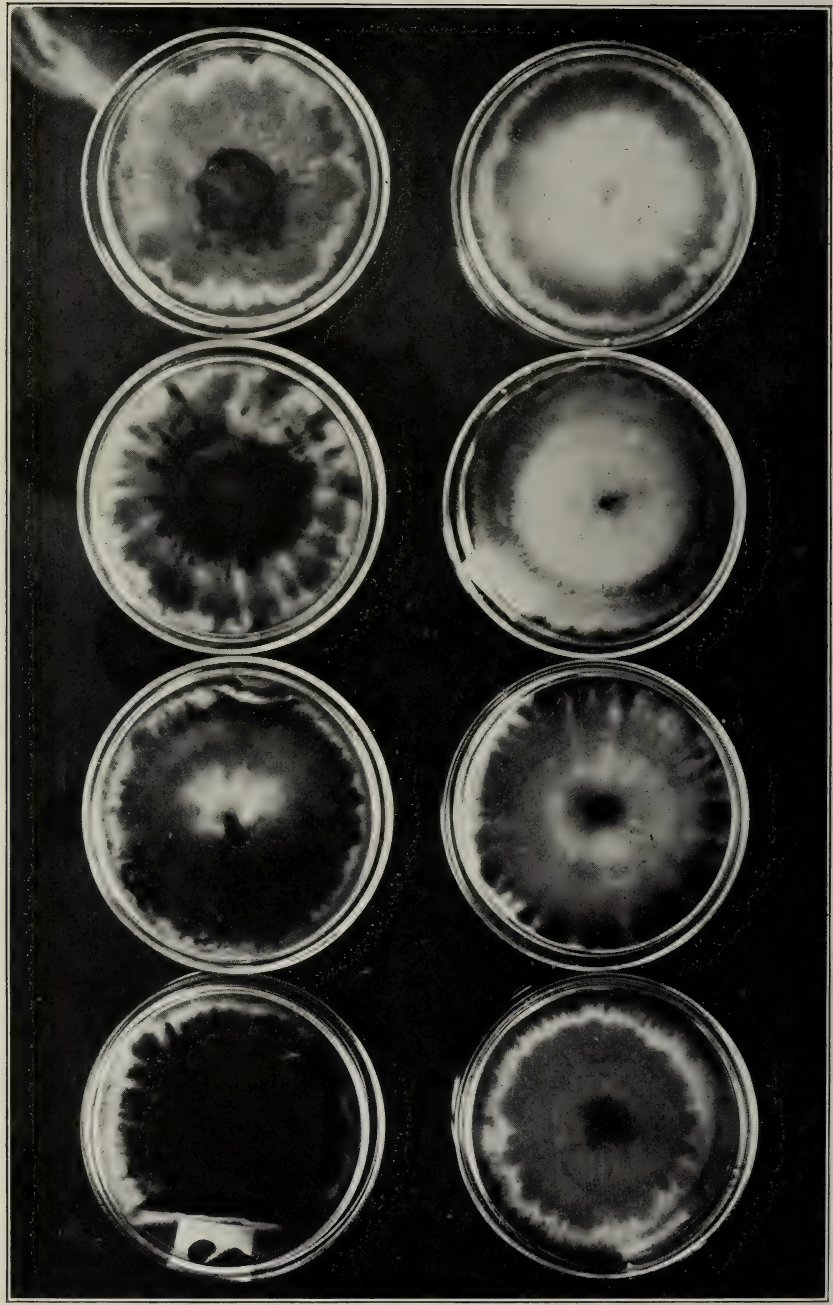

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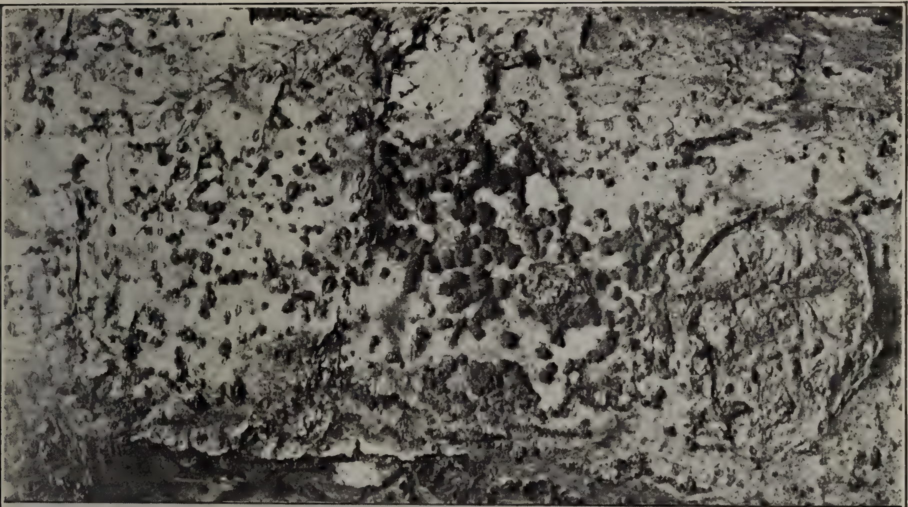

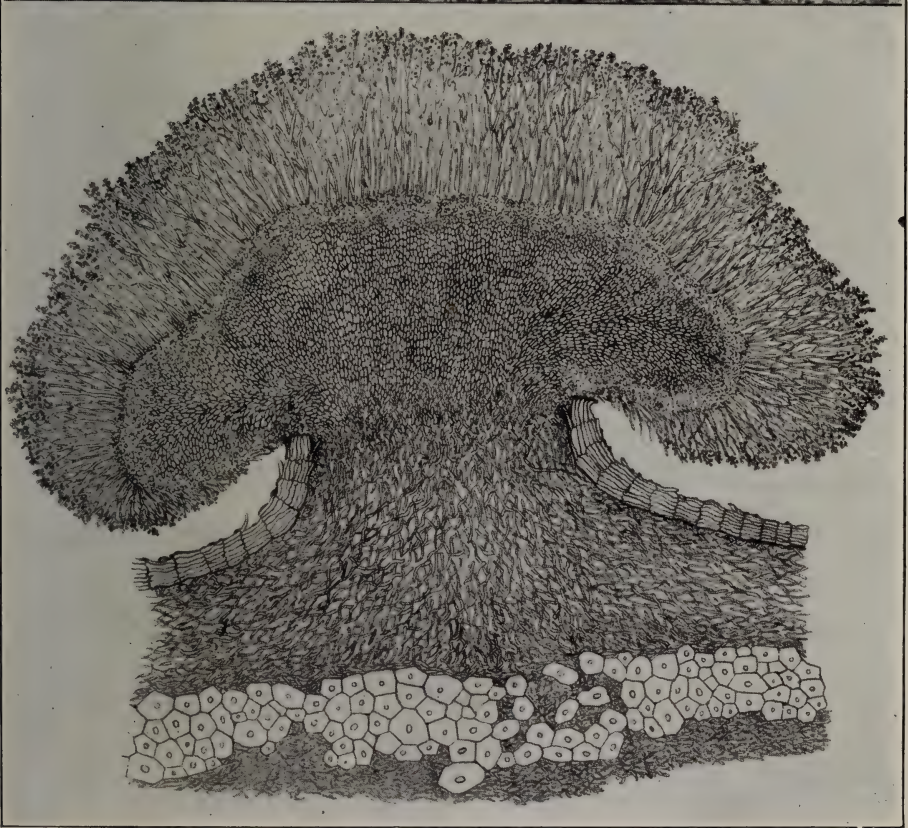

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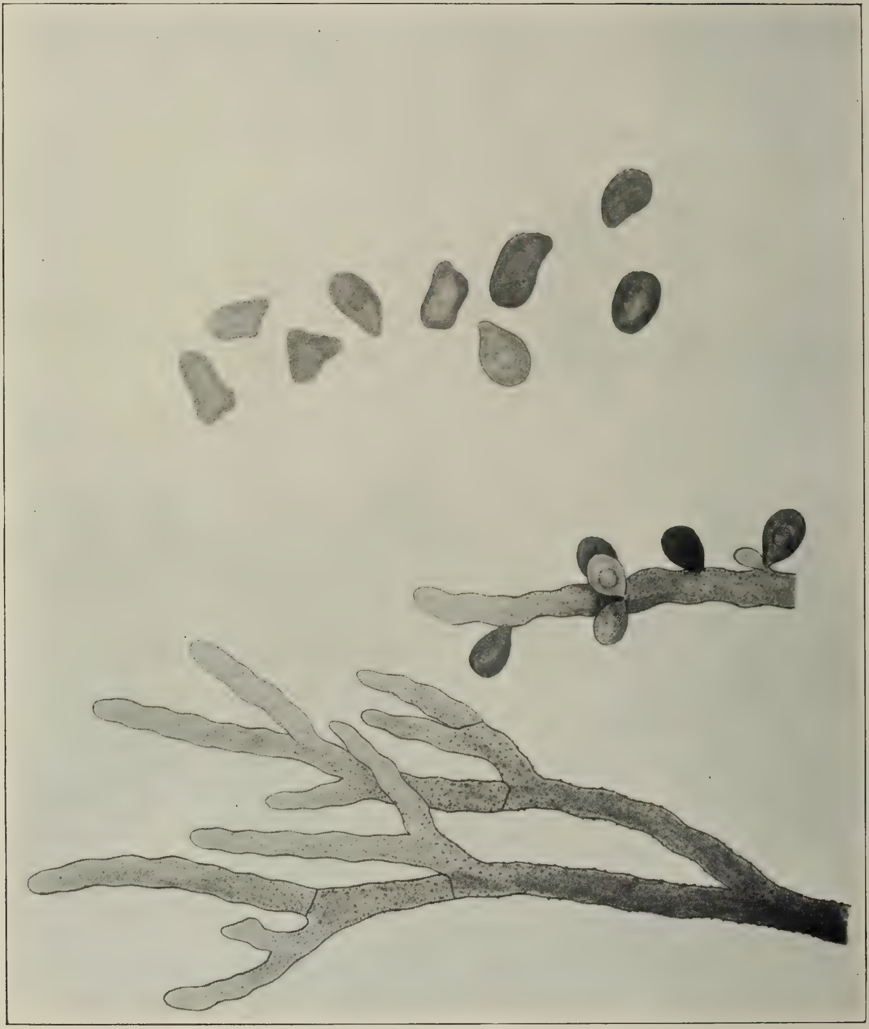

Fig. 20.

Fig. 21.

Fig. 22.

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DEPARTMENT OF FORESTRY

BULLETIN NO. 11.---JUNE, 1914.

PENNSYLVANIA TREES

BY

J. S. ILLICK, A. B., F. E.,
Professor of Dendrology and Forest Management,
Pennsylvania State Forest Academy.

ISSUED BY DIRECTION OF THE COMMISSIONER OF FORESTRY.

HARRISBURG, PA.:
WM. STANLEY RAY, STATE PRINTER
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Commonwealth of Pennsylvania

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VIRTUE
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PENNSYLVANIA DEPARTMENT OF FORESTRY

ROBERT S. CONKLIN,
Commissioner of Forestry.

IRVIN C. WILLIAMS,
Deputy Commissioner of Forestry.

STATE FORESTRY RESERVATION COMMISSION.

ROBERT S. CONKLIN,
President.

SIMON B. ELLIOTT

J. LINN HARRIS

FRANK L. HARVEY

WM. P. STEVENSON.

⁂

LETTER OF TRANSMITTAL

Hon. Robert S. Conklin,
Commissioner of Forestry.

Dear Sir: In compliance with your request I have the honor to transmit herewith the manuscript, plates, and photographs for a bulletin on "Pennsylvania Trees." It is the hope of the writer that the bulletin may aid in developing a fuller appreciation of the importance and value of our trees and forests.

Yours respectfully,

J. S. ILLICK.

Mont Alto, Pa.,
June, 1914.

PREFACE

Trees are among the commonest and most conspicuous objects of nature. The numerous products derived from them are very useful, often indispensable. In all ages trees and grasses have been the most important products of the soil. A dense and valuable tree growth covered originally almost the entire area of Pennsylvania. About 278 species of trees and shrubs are native to this State, of which number 125 are trees. The number of native representatives in the present forests is the same as in the original forest. While the number of representatives remains the same, yet one finds a marked difference in the degree of their abundance, and in their age, size, form, density, quality, value, and productivity. The original forest of the State was large, dense, and extremely productive. The present forests are small, open, and very unproductive. Each generation of mankind has seen a smaller, more open, and less productive generation of forests. It is not a prophecy, but the statement of a fact, when we say that the source of our timber supply is becoming an acute and vital question. Fast-vanishing forests and ever-rising lumber prices are couriers of this fact. The Federal and some State Governments have already inaugurated policies to offset the present destructive tendency in our forests by starting constructive work. To date no state has made a greater advance in forestry than Pennsylvania. She has, however, just started on this useful mission. The men who are directing her forest policies are endeavoring to lay a substantial foundation upon which a stable superstructure may be reared. In order to accomplish this it is necessary to have the co-operation of the citizens of the State, especially the woodland owners and managers. Forestry needs the support of public sentiment. No substantial and permanent advance is insured until our citizens understand the fundamentals of forestry and can distinguish the important timber trees from the inferior weed trees. It is hoped that the sphere of usefulness of this bulletin will not be limited to woodland owners and managers, but will extend to laymen, students, and botanists.

Part I is intended for the layman and the beginner of forestry. A careful perusal of this part will enable one to comprehend Part II more fully. The former comprises abstracts from the author's lectures on Elementary Forestry at the Pennsylvania State Forest Academy.

Part II is essentially a manual of Pennsylvania trees. It comprises a discussion on the identification of trees and a description of families, genera, and species, with accompanying keys. The descriptive material and keys are the outgrowth of typewritten outline notes prepared by the author and used for the past six years in connection with a course in dendrology given at the Pennsylvania State Forest Academy. Each species is described under about 14 headings. No special originality is claimed for the characteristics given under these headings. It is natural to expect that the descriptive material should correspond with that found in other texts. The author is glad to acknowledge his indebtedness to the many books of reference which were frequently consulted to verify observations and to make the description clear and complete. The range of the species and the weight per cubic foot of their wood (air dry) have been drawn chiefly from Sargent's "The Silva of North America." The distribution in Pennsylvania was worked out in co-operation with the foresters connected with the Department of Forestry and a few others interested in the distribution of trees. Porter's "Flora of Pennsylvania" aided considerably in determining the distribution. Our present knowledge of the distribution of the different species in the State is by no means complete. Special efforts are being put forth to ascertain it more accurately. Future publications will contain the results of the present and prospective surveys covering the distribution of our trees. Any additions, suggestions, or corrections will be gladly received.

The scientific names found in this bulletin are those used by the Department of Forestry, which follows the usage of the seventh edition of Gray's New Manual of Botany. Shifting of individual plates from their proper systematic position was necessary in a few cases in order to place two companion plates on opposite sides of the same sheet.

The photographic illustrations, 103 in number, are all original by the author, except Figs. 57 and 63 supplied by W. Gardiner Conklin; Fig. 22 supplied by Guy Carleton Hawkins; Figs. 21 and 35 supplied by B. J. Gutknecht, and Figs. 1, 3, 4, 10, and 12 supplied by the Pennsylvania Department of Forestry.

The drawings have been made by Miss Margaretta Washington, of Philadelphia, either from specimens supplied by the author or redrawn and adapted from Sargent's "The Silva of North America" by special permission of the publisher, Houghton Mifflin Company. In making some of the drawings Schneider's "Dendrologische Winterstudien" and some of the reports of the Missouri Botanical Garden were consulted.

Grateful acknowledgment is tendered to Hon. Robert S. Conklin, Commissioner of Forestry, at whose suggestion the bulletin was started and under whose careful and constant direction it was developed. Especial acknowledgment is due to Hon. I. C. Williams, Deputy Commissioner of Forestry, who read the entire manuscript, for his inspiration, many valuable suggestions and criticism. Thanks are due to George H. Wirt, Forest Inspector, and Prof. George A. Retan for their assistance and valuable suggestions.

I take pleasure in expressing my gratification to all others who have in any way assisted in this publication, especially the students of the Pennsylvania State Forest Academy for their co-operation, and the graduates for their assistance in collecting data concerning the distribution of trees in this State.

J. S. ILLICK.

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PART I.

INTRODUCTORY.

THE NORTH AMERICAN FOREST.

There is good reason to believe that the major part of the habitable earth was originally wooded. North America is no exception to this. The original forest extended from the Atlantic coast west to about the ninetieth meridan having only a few small openings like meadows and the tops of mountains. It also covered a large portion of the Rocky Mountain region and the Pacific slope. Estimates place the aggregate original area of the forests of North America at about 850,000,000 acres. This original area has been so reduced that not more than 550,000,000 acres remain at the present time and a large portion of this acreage is in a very unproductive condition.

The original forest of this country was vast in extent and composed of many and valuable species. The richness and variety of our tree growth may be in part attributed to the different climatic zones and variable physiographic features common to this country. So variable is our forest structure that at least five general forest regions may be recognized while often a local area may have its own peculiar forest type.

Many of the trees in the original forest attained a great age and enormous size. They yielded a vast amount of valuable products, a source of great wealth, which has been supplying the raw material for one of our most important industries. Nature working through many centuries developed the original forest and gave it to us gratuitously. Man working through only a few centuries has established a great industry—the lumber industry; but on the other hand he has wastefully exploited our forests and left many of them in an unproductive condition. However, there was no alternative because the economic conditions then prevailing required, in part at least this wasteful procedure.

FORESTS OF PENNSYLVANIA.

The word Pennsylvania means Penn's woods. It derived its name from its early proprietor and the dense and extensive forest growth which covered the State. The original forest covered almost its entire area, which is usually given as 28,594,560 acres. Practically the entire State, with the exception of a few natural meadows and the tops of a few mountains, was covered with trees. The original forest was composed of many and valuable species often occurring in dense stands. The richness of our forest flora is due to its favorable location with reference to climatic and physiographic factors. Pennsylvania is the meeting ground of many northern and southern species. In the western part of the State one finds outposts of species common to the Mississippi valley, while in the southeastern part some of the species of the coast region are found. Some of the northern species have their southern limits here, or else follow the mountains toward the south, while some of the southern species have their northern limits here, usually migrating northward through the valleys. The forests in the southeastern and the western parts of the State are composed almost entirely of hardwoods, while the central and the northern or mountainous parts are composed of a mixture of hardwoods and conifers. One may find the hardwoods by themselves and the conifers by themselves, or they may occur in mixture. A few of our native species are very valuable, while others are less valuable and some mere forest weeds. The real value of a species changes with the change of the general economic, particularly market, conditions. Within the last decade market prices of wood have risen so much that they have brought about a more intensive utilization of our forest products. Many species formerly left standing in the forest are now utilized. A moment's reflection upon the present tendency in the utilization of the products of the various trees causes us to comprehend fully the truth of the statement that the despised species of to-day will be prized tomorrow. The richness of the arborescent flora together with the great age and large size which some of the trees attained justifies the statement that Pennsylvania was at one time "one of the best timbered states of the Atlantic Coast."

Nature working through many centuries developed in this State a forest which was one of the most valuable of the many heritages with which its citizens have been blessed. If we could see maps showing the structure and distribution of the forests of Pennsylvania in the years 1600 and 1900, we would be astonished by the wonderful change that has taken place in a period that represents only a few generations of trees. Many were the agents which brought about this change, but it was left to man to play the leading role. Man working through a few centuries has removed the forest or abused it through fire and unregulated cutting. The establishment of pioneer homes, the opening of agricultural and grazing lands, the increase of population, the development of industrial enterprises, the

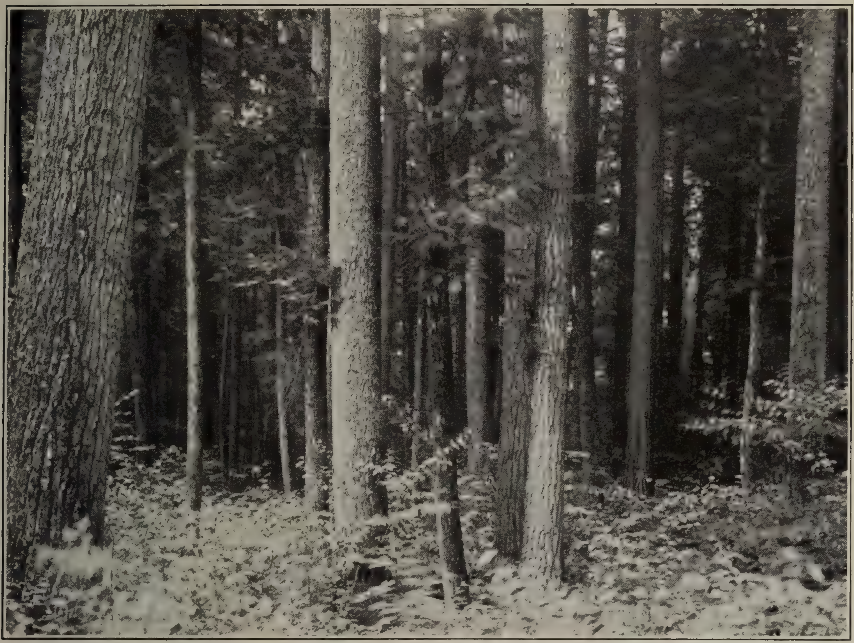

Fig. 1. STAND OF PENNSYLVANIA VIRGIN WHITE PINE.
The kind of forest our forefathers found. A magnificent heritage. The real value was not appreciated.

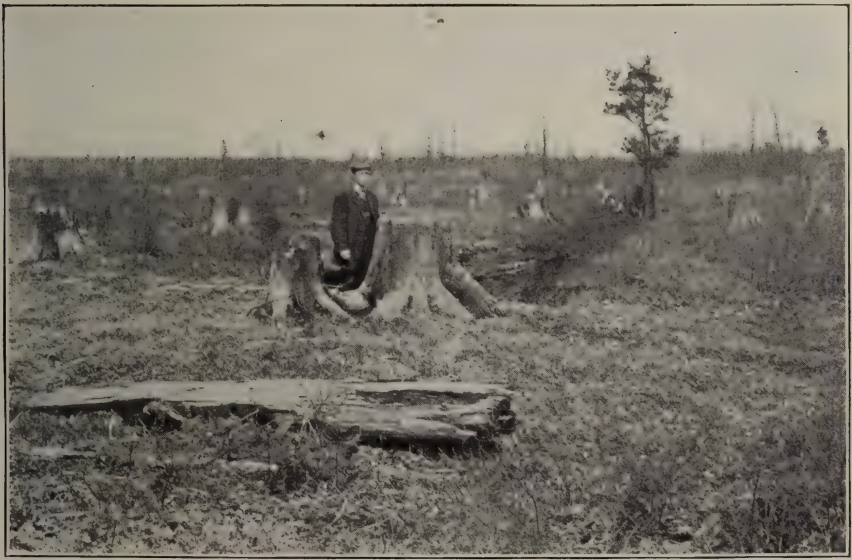

Fig. 2. RESULT OF EXTENSIVE FOREST EXPLOITATION.
High stumps, and a thin scattered growth of inferior trees, is all that remains. The stumps indicate the density and size of the original stand.

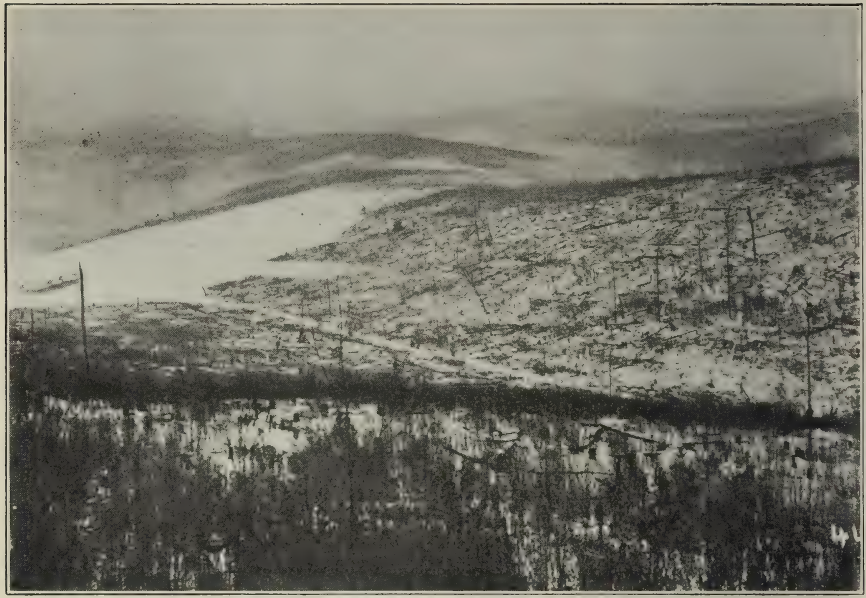

Fig. 3. ACRES OF DESOLATION.

More than 5,000,000 acres of such barren land are found in Pennsylvania. Much valuable timber was lost through reckless exploitation of the original forest.

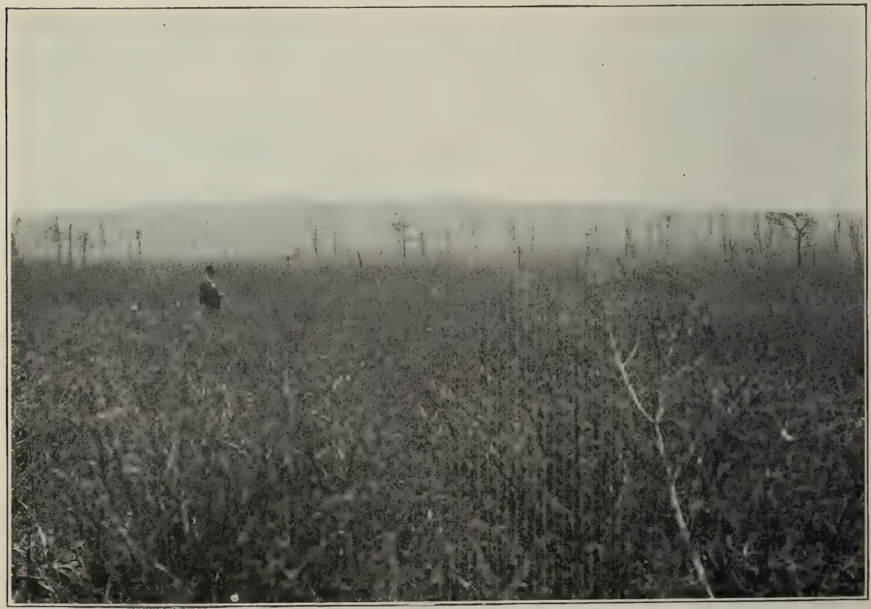

Fig. 4. ACRES OF SCRUB OAK.

Scrub Oak has no timber value. Large areas in our forests contain many weed species which often prevent other valuable trees from establishing themselves.

destructive work of lumbermen, and the advent of forestry present a picture of change and progress, which enables us in part to comprehend the important role that man played in transforming the original forest into the present forest.

Pennsylvania originally contained large, dense, and extremely productive forests. The large have become small, the dense have become open, the productive have become unproductive. Each generation of mankind has seen a smaller, more open, and less productive generation of forests. The march of forest destruction has been rapid and severe and yet inevitable on account of existing economic conditions. While originally almost the total area of the State was covered with tree-growth, to-day less than 50 per cent. is covered by woody growth and over 5,000,000 acres of this is barren or unproductive, while many more acres are poorly stocked with trees. Most of our woodland areas are at present in a very unproductive unsanitary, unattractive, and unregulated condition.

Economic conditions have changed and the old order of things need not continue. We must substitute conservative lumbering for the wasteful exploitation of the past. We must do constructive work in our forests now to recompense for the destructive work carried on during the last few centuries. We should aim to show our social and civic worth by handing down to future generations a heritage equivalent to that which we received from our forefathers. In order to do proper constructive work it is necessary to establish a goal or an ideal and develop proper methods by which it can be reached or at least approximated. We need not be entirely original in this work since a few countries like Germany, Switzerland, and France have already in more than a century of experience laid the foundation for conservative and constructive forestry. We can learn much from these countries. A visit to their carefully managed forests together with a general survey of the methods which they use in managing them will be helpful in formulating plans for our Ideal or Normal Forest. We may not be able to adopt their methods but we can at least adapt them. The question at once presents itself: How can we improve our woodlands so that they will approach the well-managed forests of Germany, or the ideal or normal goal which we are setting up for them? The following answers suggest themselves:

1. By giving adequate protection. Fire is the chief agency against which our forests need protection.
2. By procuring wise taxation.
3. By prohibiting unregulated cutting.
4. By securing quick reproduction after the removal of the timber.

5. By establishing a complete stock of valuable trees on all forest soils.
6. By removing undesirable stock and replacing it with a better class of trees.
7. By establishing a proper proportion and a suitable distribution of age classes.
8. By making every part of the forest accessible by means of roads, lanes, trails, paths, compartment lines, etc.
9. By making improvement cuttings.
10. By dividing the forest into working units (compartments) just as a farmer divides his farm into fields and the fields into patches.

THE FORESTS AND FORESTRY.

The original forest was so modified by the activity of man, or man working conjointly with natural agencies, that the source of our future wood supply became a question of great importance. A general survey of the field showed that we were consuming wood faster than we were producing it. This unbalanced economic condition due to the unregulated condition of our forest gave birth to the subject of forestry. Man's attitude towards the forest showed that he was a disturbing agent. Without him the forest of Pennsylvania would have remained practically undisturbed, indefinitely. Hence it might follow that the forest thrives best where there are no people, and consequently no forestry. Further, one often hears the statement: Formerly we had no forestry and plenty of wood; now we have forestry but no wood. This statement does not prove that forestry is to be blamed for a deficiency in our wood supply, but it does prove that forestry is the child of necessity. This child of necessity, which is at present just in its formative period, could never have been born if we had not been compelled to see that our timber resources were rapidly decreasing.

The word forestry to many may be new. The most enlightened may have a rather vague conception of its exact scope. It is often identified with the planting of individual trees, landscape work, and tree surgery. Forestry should be regarded as the rational treatment of our woodlands for their products. The kind of treatment depends largely upon the desire of the owner. The ownership may be private or there may be a public owner, as a municipality, a state, or a nation. The desire of the owner may be to supply wood material, to retain or establish a protective cover, to furnish recreation grounds, or to maintain a game cover. The forests which are managed for the purpose of producing a supply of woody material are known as *production forests* or *supply forests,* while those which

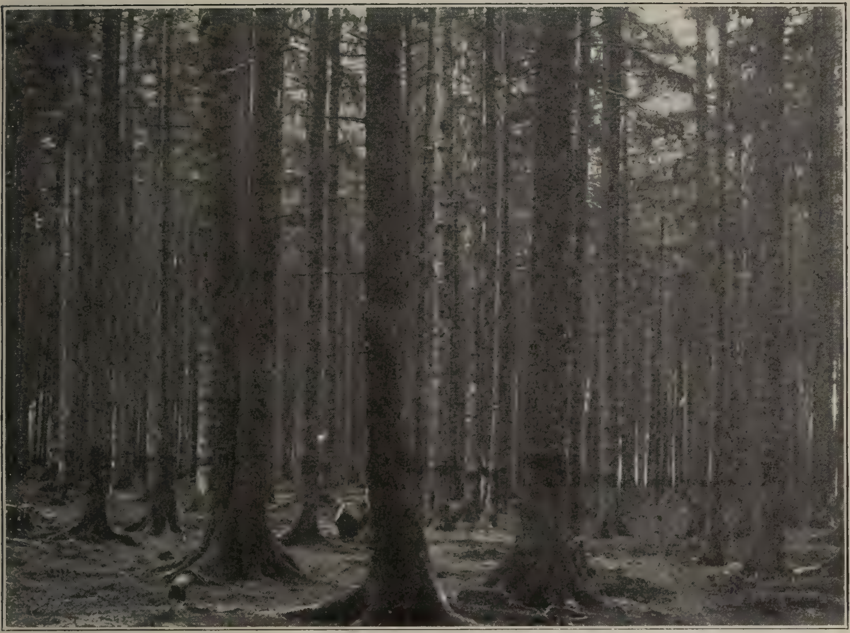

Fig. 5. DENSE STAND OF NORWAY SPRUCE, GERMANY.
The kind of forests we hope to develop. Norway Spruce is a valuable and a beautiful tree.

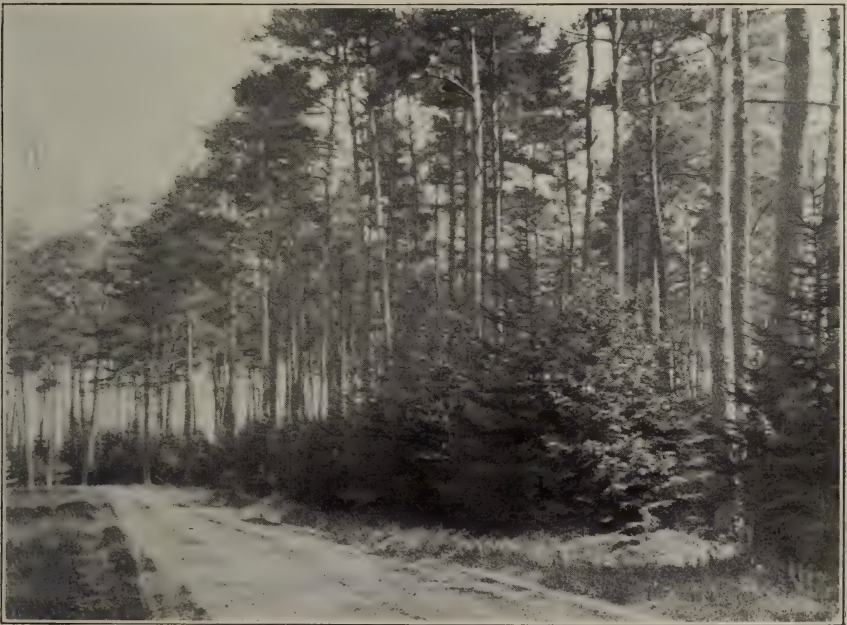

Fig. 6. CAREFULLY MANAGED FOREST.
Attractive, sanitary, productive, and organized. Good roads ramify through all its parts.

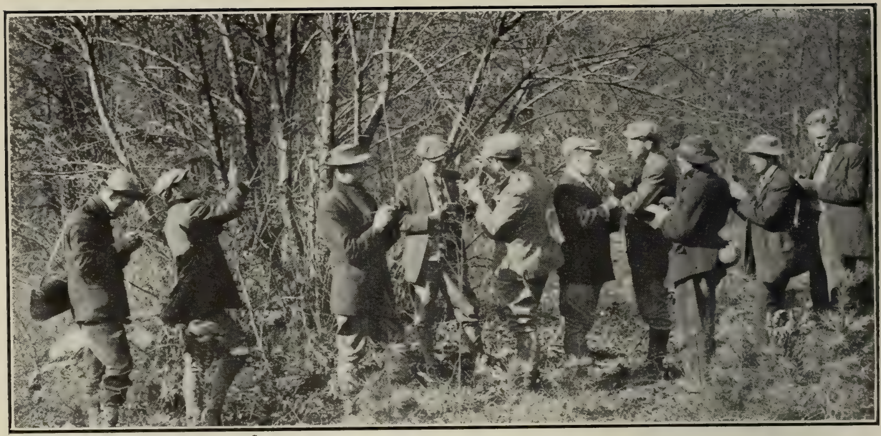

Fig. 7. FOREST ACADEMY STUDENTS IDENTIFYING TREES IN WINTER.

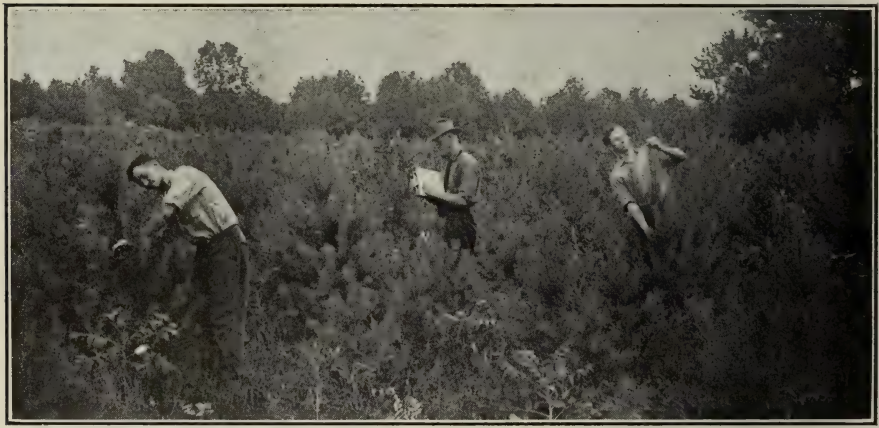

Fig. 8. FOREST ACADEMY STUDENTS STUDYING THE GROWTH OF TREES IN A PLANTATION.

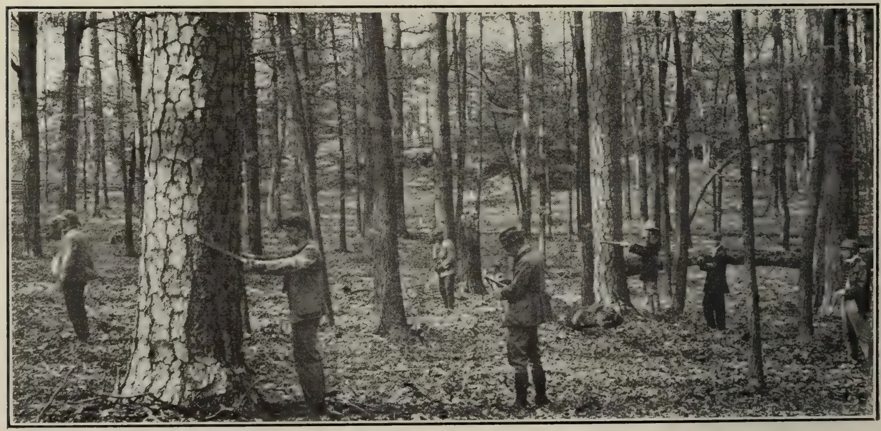

Fig. 9. FOREST ACADEMY STUDENTS ESTIMATING TIMBER.

are retained or often established as a protective cover are known as *protection forests.* Protection forests aim to prevent calamities like destructive floods, excessive erosion, sand shifts, and snow shifts. Forests managed primarily to enhance the beauty of the forests and to furnish recreation grounds for the public may be known as *park forests.* Park forests should always be accessible to the public. Such outing grounds will not only be a means of preventing many of our diseases but also help to restore to health those who are already afflicted. Forests managed by the owner primarily to enjoy sport are known as *luxury forests.*

Forestry aims to have man improve upon nature's ways of doing things. Nature grew forests upon areas regardless of the fitness of these areas to other more profitable pursuits. Both the thin, relatively sterile soils of the mountains and the deep, fertile soils of the valleys were covered with forests. The latter are far more valuable for the production of food material than for the production of wood material. Forestry aims to develop forests on forest soil. It does not attempt to encroach on agricultural soil but aims first to classify the land into ploughland and woodland; and then to treat the woodland areas so that they will yield the largest quantity of high class wood material in the shortest time at the least expense of time and money and to give to mankind as many other natural blessings as possible. The economic point of view should always be kept paramount. The forester's forest should supply more fully the present and prospective human wants than they can be supplied by depending upon nature's uncertain and unregulated performances.

FORESTRY IN PENNSYLVANIA.

Forestry had an early beginning in Pennsylvania. As early as 1681 William Penn in his Charter of Rights stated that "In clearing the ground care should be taken to leave one acre of trees for every five acres cleared; especially to preserve the oak and mulberries for silk and shipping." From this time on at irregular intervals acts were passed by the legislature protecting the woodlands from theft and firing; but no real, constructive work in forestry was done until the latter part of the 19th century.

In 1855 F. Andre Michaux left a legacy of $14,000 to the American Philosophical Society in Philadelphia which became available in 1870 for forestry instruction. In 1877 Dr. J. T. Rothrock, Professor of Botany at the University of Pennsylvania, was appointed Michaux lecturer on Forestry, in which capacity he served until 1891. At this time it was difficult to interest the public in forestry and, as a consequence, at first, the lectures delivered by Dr. Rothrock were not well attended. The interest in forestry, however, grew gradually and cumulatively.

In June, 1886, the Pennsylvania Forestry Association was founded. It has always been and is still one of the best and most constructive organizations of its kind in America. In 1888 Governor Beaver appointed a Commission on Forestry, which was the first commission of its kind in this State. It presented a report to the legislature in 1889. The reports which this and the subsequent commission presented to the legislature, together with the data obtained from the tenth census (1880), helped to stimulate interest in forestry on the part of both legislators and the public. In 1895 the Division of Forestry was created in the Department of Agriculture and Dr. J. T. Rothrock was appointed Commissioner of Forestry. He served in this capacity until June 1, 1904, when he resigned. Hon. Robert S. Conklin, the present incumbent, succeeded him as Commissioner of Forestry. Under the direction of these able men the forestry work has progressed to such an extent in less than two decades, that Pennsylvania to-day stands in the front rank with reference to the development of its woodland areas. Many constructive acts pertaining to forestry have been passed by the legislature, some of which have served as models for other states. In 1901 the Division of Forestry was raised to a Department of Forestry.

In 1903, by a special act of the legislature, the State Forest Academy, at Mont Alto, was established. Mont Alto is a small village in Franklin county, sixty miles southwest of Harrisburg on the Cumberland Valley Railroad. The ground occupied by the school buildings is a part of a State forest which affords an excellent opportunity for practical instruction and an accessible field for experimentation equalled by few if any forestry schools. Recently one of the leading forestry educators connected with an American University, a German by birth, in a public address said, "The Pennsylvania State Forest Academy has the best location and working field of any forestry school in the world." This school aims to train young men in practical forestry so that they will be able to manage the State forests. Sixty-four men have been graduated, and most of whom are still in the service of the State. In addition to these foresters ninety-two rangers are also employed. A printed announcement of the school is available for free distribution and will be sent upon request.

The State authorized the purchase of woodland areas in 1897 for the purpose of establishing State forests. To date (July 1, 1914) 998,773 acres have been acquired, located in 26 counties, at a total cost of $2,273,647.46, or an average of $2.27 per acre. This area is now being developed. Over 5,000 miles of roads, lanes and trails have been built, opened, or repaired. One hundred ninety-five miles of telephone lines have been built and numerous fire observation towers have been constructed. The Department of Forestry aims to disseminate knowledge concerning forestry to the public, to protect carefully all State forests, to assist in the protection of private areas, and make accessible for management and utilization all State forests as rapidly as appropriations by the legislature will permit. Many large areas in various parts of the State are devoid of any valuable tree growth. Most of these areas are capable of developing useful forests. In order to have them developed it is necessary that such areas be stocked with valuable trees. It must be done by planting. About 6,000 acres have already been planted to trees in this State, which required a total of 11,970,500 seedlings. In order to produce these seedlings and to insure a future supply 4 large forest nurseries and 22 small ones have been established. Many other benefits are derived from the forests. They serve as recreation grounds to the public who seek their midst to regain or maintain health. Carefully managed forests regulate stream flow and are also the sources from which cities and towns obtain an excellent supply of unpolluted water. They furnish local labor, and, through permits, suitable camp sites to campers, hunters, and fishermen. The sale of material from the State forests has already yielded over $84,000, eighty per cent. of which will be set aside for "The State School Fund of Pennsylvania."

THE STRUCTURE OF THE FOREST.

Every region and, often, even every small locality has its peculiar kind of forest. The composition of the forests along streams, on slopes, and upon mountain tops usually shows great differences. The climatic factors and physiographic features of a region influence the composition of the forest very much. The more varied the factors of the habitat are, the more varied the composition of the forest usually is. Upon the same mountain slope one can often find three and sometimes more zones of trees. Each zone is composed of different species or groups of species, which groups vary not only in composition, but also in form, density, and thriftiness.

The forester seldom considers trees raised in isolated positions, but rather concerns himself with trees raised in masses or stands. Such masses of trees, irrespective of their kind, size, density, form, number, or value are known as woodlands. Woodlands may be composed of a single species or of two or more species. If one species composes ninety per cent. or more of the total stand it is known as a *pure stand* and if the stand is composed of two or more species none of which forms ninety per cent. of the total stand it is known as a *mixed stand.* Woodlands are rarely quite pure. A slight admixture of some species is usually present. The forests of Pennsylvania are decidedly mixed in their composition. The conifers are found oftener in pure stands than the broad-leaved species. Since the forests of this State are composed largely of hardwood species it is rather unusual to find pure stands. Occasionally one may find small pure stands of such species as Pitch Pine, White Pine, or Red Cedar and rather extensive ones of Chestnut.

About 125 species of trees are native to the State of Pennsylvania but not more than 25 species are of sufficient importance to deserve to be developed in our future forests. A large proportion of our native trees is found as undergrowth. They form dense and sometimes almost impenetrable thickets. This dense and complex structure of our underwood aids considerably in increasing the number of participants in our forests. Dense and tall undergrowth tends to protect the soil from erosion, to conserve the fertility of the soil, and to afford shelter to birds which prey upon the insect enemies of the forest; but it may also impede the utilization of forest products and make the tending of the forest more difficult.

The tendency of forestry is to eliminate the undesirable species. We should eliminate cautiously since the despised species of to-day may be prized to-morrow. If this process of elimination is developed on an intensive scale, it means a reduction in the number of species and, in extreme cases, leaves only one species, i. e. a pure stand. This is especially true where a forester aims to establish a stand by artificial seeding or planting. He is apt to choose a species, which he thinks will give the highest returns. If he selects the proper species and it is not injured during its development he may possibly obtain satisfactory results. Before establishing stands one should consider the subjoined advantages of pure and mixed stands. The principal advantages of pure stands are:—

1. Pure stands are easier and cheaper to establish.
2. Pure stands are easier to tend and manage.

The principal advantages of mixed stands are:—

1. Mixed stands utilize the available plant food in the soil and air more fully. Close utilization of the factors of the habitat and keen competition by every forest tree upon its neighbor are requisites for optimum quantity and quality production.
2. The forester can meet the demands of the market better with a few species than with one species.
3. A larger number of trees per unit of area is usually found in a mixed stand than in a pure stand.
4. Many species are less subject to damage by wind, frost, fire, fungi, and insects, in mixture than when grown pure.
5. Trees usually develop a better form if mixed properly than if grown pure.
6. Mixed stands are more attractive than pure stands.

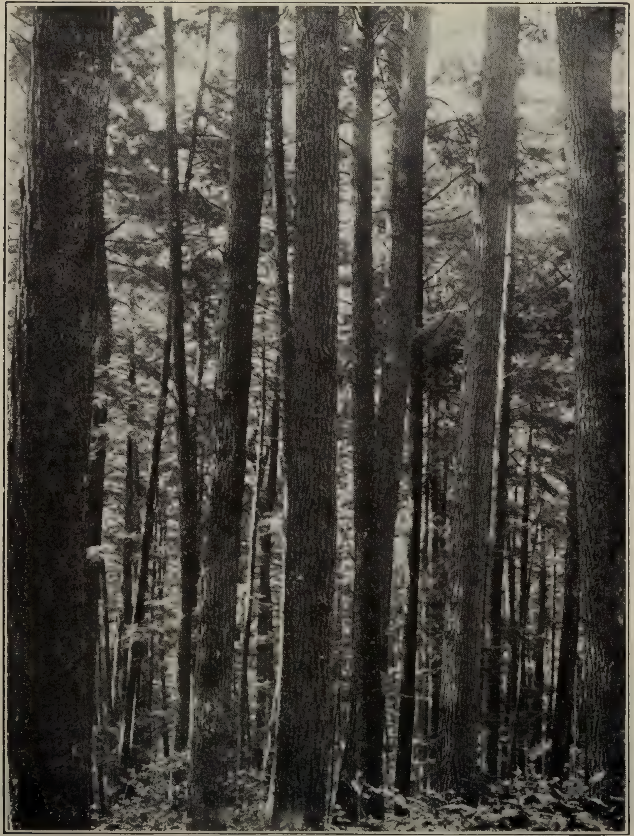

Fig. 10. PURE STAND OF WHITE PINE.

A dense stand with clean stems and little taper. All age-classes represented.

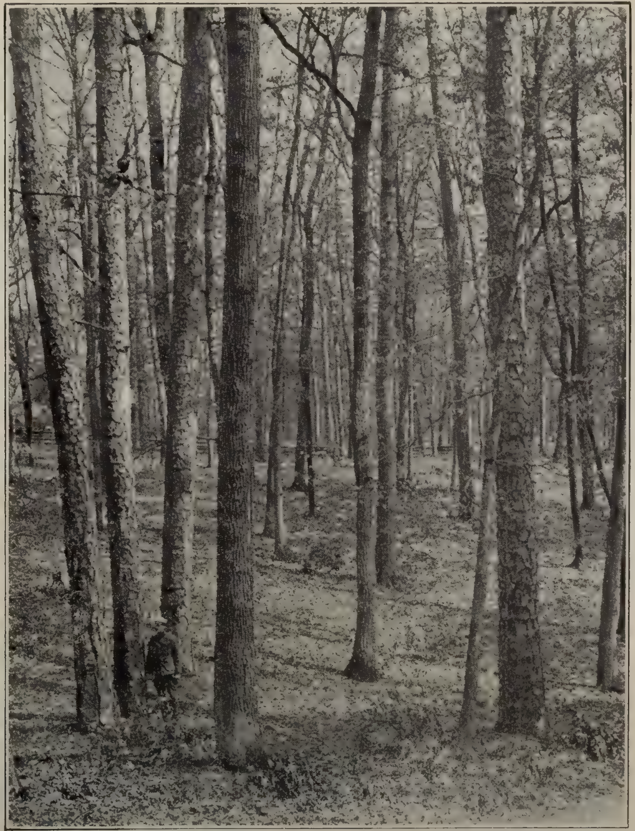

Fig. 11. MIXED STAND OF OAK, HICKORY AND YELLOW PINE.

Will yield about 18,000 board feet per acre. Such stands are rare to-day. Franklin county, Pennsylvania.

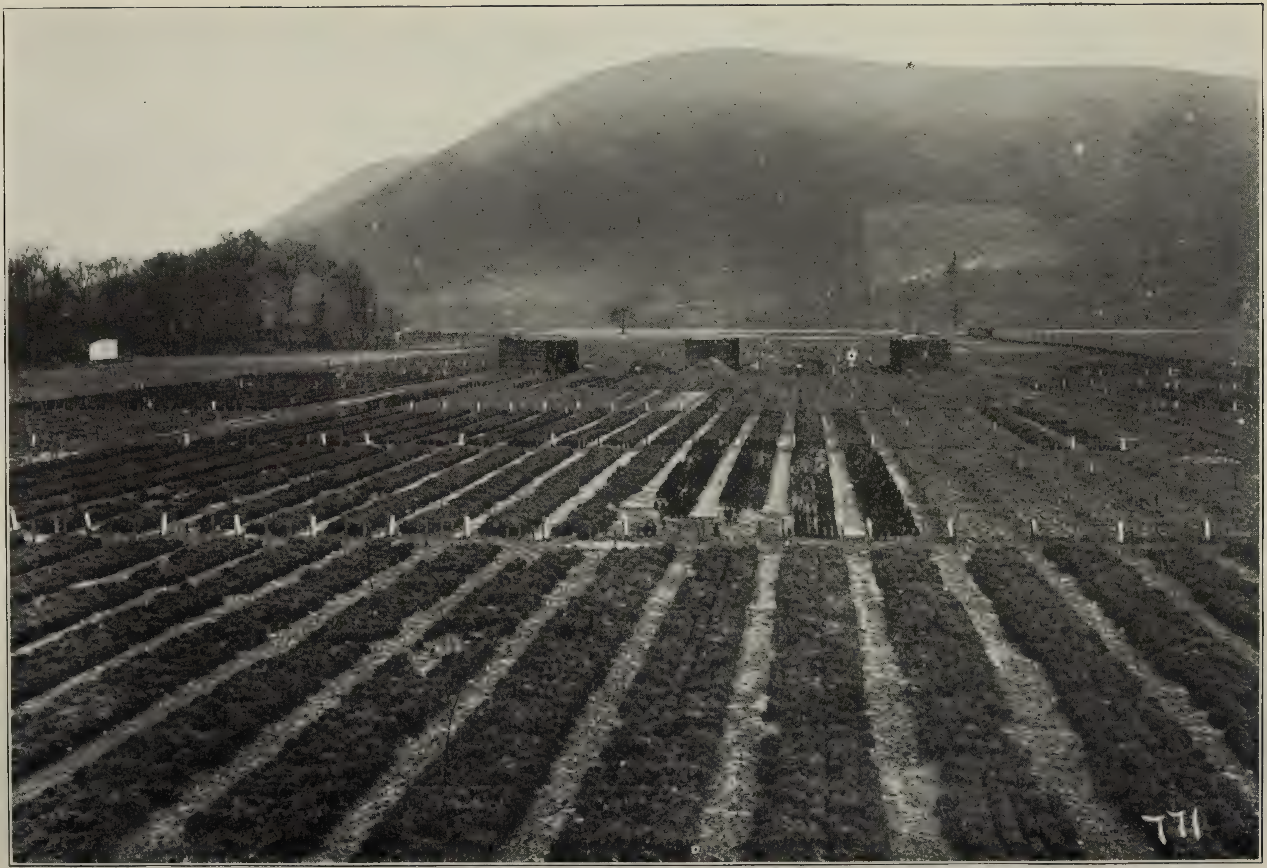

Fig. 12. FOREST TREE NURSERY, ASAPH, PENNSYLVANIA.
Furnishes about one million seedling trees annually.

A great many pure stands may be seen in the forests of Germany. Some of them were established over 100 years ago and are now ready to be cut. After more than a century of experience in planting, the German foresters are abandoning the policy of establishing pure stands and are advocating mixed forests. Mixed forests may consist of a mixture by single trees or of a mixture by groups. The mixture may be temporary or permanent, even-aged or uneven-aged.

We should aim to improve the composition of our forests by reducing the percentage of inferior species and increasing that of the more valuable ones. The present cover types which consist of many despised, some neutral, and a few prized species, should be transformed into the future management types which will be characterized by a simpler but superior composition.

THE ESTABLISHMENT OF THE FOREST.

As rapidly as the mature forests on absolute forest soil are removed they sould be succeeded by young forests. These new forests which follow in the wake of those removed may be established by one or by a combination of the following methods:—(1) *Natural,* where nature, aided to a limited extent by man, sows seeds and produces sprouts. (2) *Artificial,* where man sows the seeds or plants the seedlings. The former is usually spoken of as natural regeneration and the latter as artificial regeneration. In both methods nature does most of the work; but man helps nature more in the artificial method than in the natural method. Nature working through many centuries produced the original forest. We cannot wait for nature to produce another original forest on our forest soils. It will take too long. We may assist nature and attempt even to improve upon its way of doing things; but we must be careful that we do not deviate too far from its methods for fear of being punished.

In the case of artificial regeneration it is necessary to collect seeds from desirable trees. These collected seeds may be sown immediately or stored. If stored, they must be protected from such animals as mice, squirrels, and birds, and from drought. The seeds may be placed between layers of sand to prevent drying out. Those seeds which are sown immediately may be sown directly upon the area where they are expected to germinate and establish themselves or they may be sown in beds in a nursery where they in time develop into seedlings. Direct sowing may be in the form of broadcasting, where the seeds are scattered rather uniformly over the area or spot planting, and where only isolated or scattered spots, often regularly spaced, are sown with seeds.

The nurseries in which the seeds are sown may be permanent and located in the open, or temporary and located in the forest under the shelter of trees. The nursery is divided into a great number of beds which are usually about twenty-five feet long and four feet wide. The seeds may be sown in these beds in spring or fall, either by sowing them broadcast or in rills. Here the seeds germinate and after an incubation period of usually less than a month, but occasionally extending over a year, they appear above the ground. The germination can sometimes be stimulated by soaking the seeds in water before planting. These young tender plants like children succumb very readily to adverse conditions. Consequently they must receive careful treatment and adequate protection while they remain in the nursery. They must receive protection from the intense sun, excessive moisture, drought, weeds, fungi, and animals. The plants which develop from the sown seed may remain for one, two, or three years in the nursery. Those plants which remain for more than one year may be kept in the same place where the seeds which produced them were sown. If too dense they must be lifted and planted in another place where they will have more room. This process of lifting the seedlings and planting them again is known as *transplanting*, and the resulting plants are *transplants*. Transplanting usually produces better plants because they are stockier and better prepared for the shock they will receive when planted in the forest. Species like White Pine, Red Pine, and Norway Spruce are usually left in the nursery for two or three years and then transplanted while other species like Ash, Walnut, and Oak are left in the nursery only one year.

The seedlings planted in the forest are usually raised in nurseries but occasionally they may be taken from the forest floor where nature often produces them abundantly. The cost of raising plants in the nurseries varies with the species, cost and quality of the seeds. and the length of time left in the nursery, but is usually from about $2.50 to $4.00 per thousand. The source, method of collection, preparation, and storage of the seeds have a marked influence on the quality of the resulting plants. The plants, taken from the nursery or lifted in the forest, are usually planted in the forest about 4 x 4 or 5 x 5 feet apart. This requires from about 1,700 to 2,725 trees per acre. The total cost of planting an acre of cleared land to forest trees, including cost of plants, is about $12. In individual cases the cost may exceed this figure and again it may be lower. This artificial method of regeneration is generally used where forests have been clear-cut or where openings are to be reforested. It is also used for underplanting where a better humus covering is desirable. In Europe, especially in Germany, this method was used extensively during the last century as may be seen in the many even-aged forests found there at the present time. During the last decade a reaction has been setting in, based on scientific investigations. Many of the

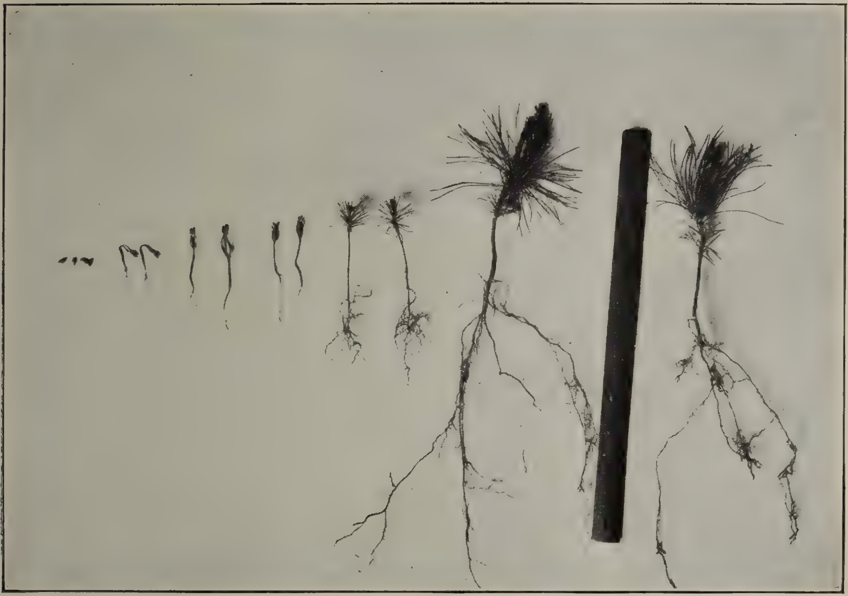

Fig. 13. DEVELOPMENT OF WHITE PINE SEEDS.

Seedlings taken from nursery May, 1914, after growth had started. From left to right: Four seeds; six seedlings from fall-sown seeds showing 3 stages of development directly after breaking through the ground; two 1-year old seedlings; two 2-year old seedlings.

Fig 14. STUDENTS PLANTING TREES.

From 1,200 to 2,750 trees are planted per acre. A crew of 20 men can plant 20,000 trees per day if conditions are favorable.

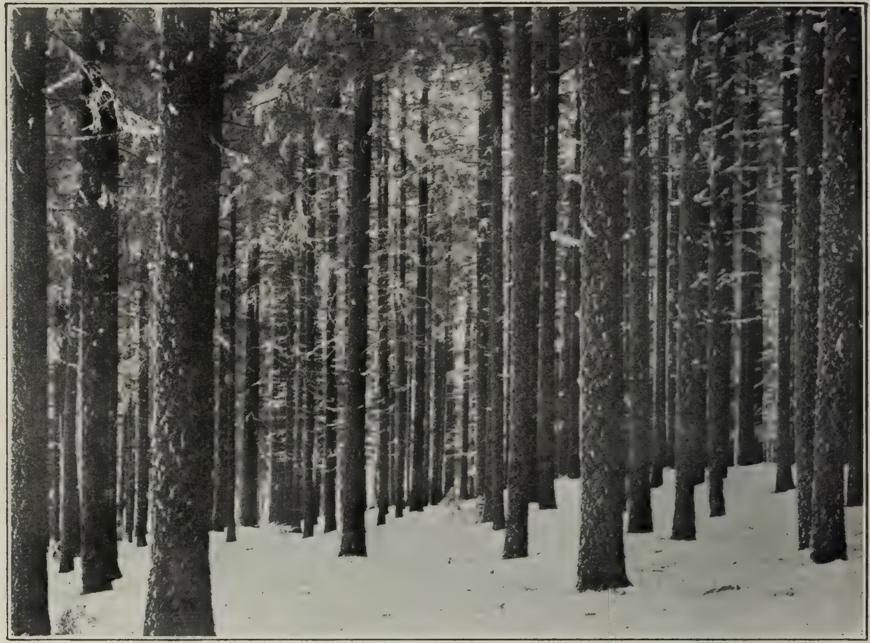

Fig. 15. NATURAL REGENERATION OF THE FOREST.

Norway Spruce before seeding cutting. Opening the leaf-canopy stimulates seed production.

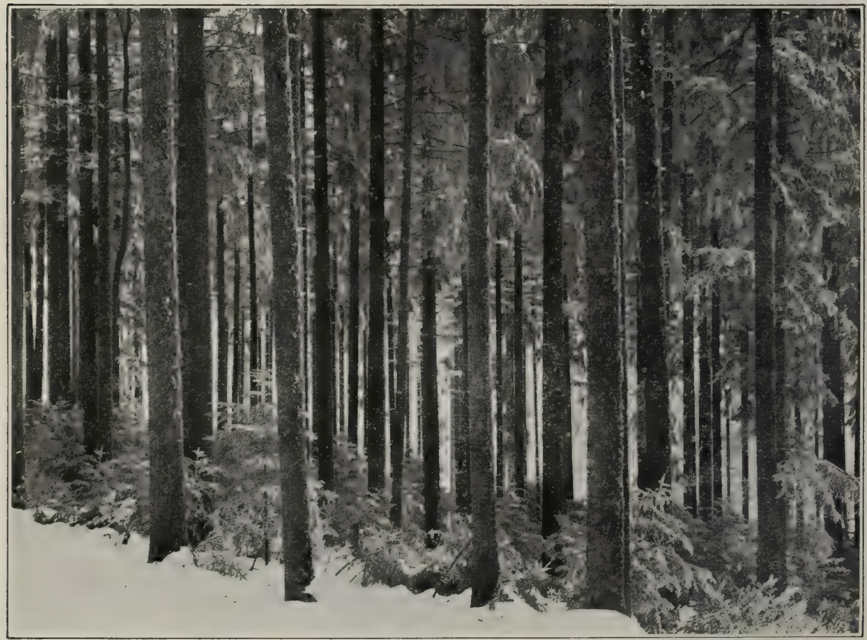

Fig. 16. NATURAL REGENERATION OF THE FOREST.

Norway Spruce after seeding cutting. Regeneration following regulated seed production.

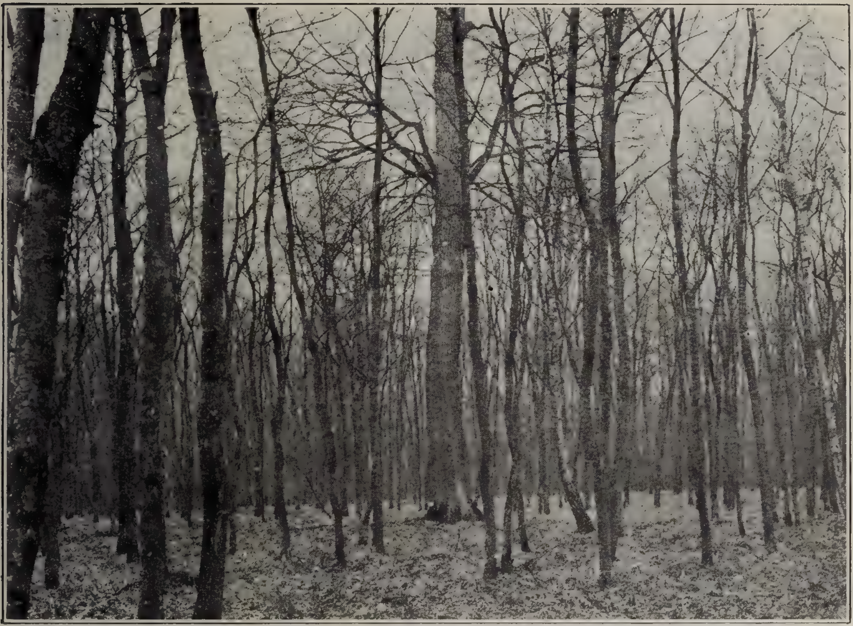

Fig. 17. NATURAL REGENERATION OF THE FOREST.
Large Oak seed tree with its offspring.

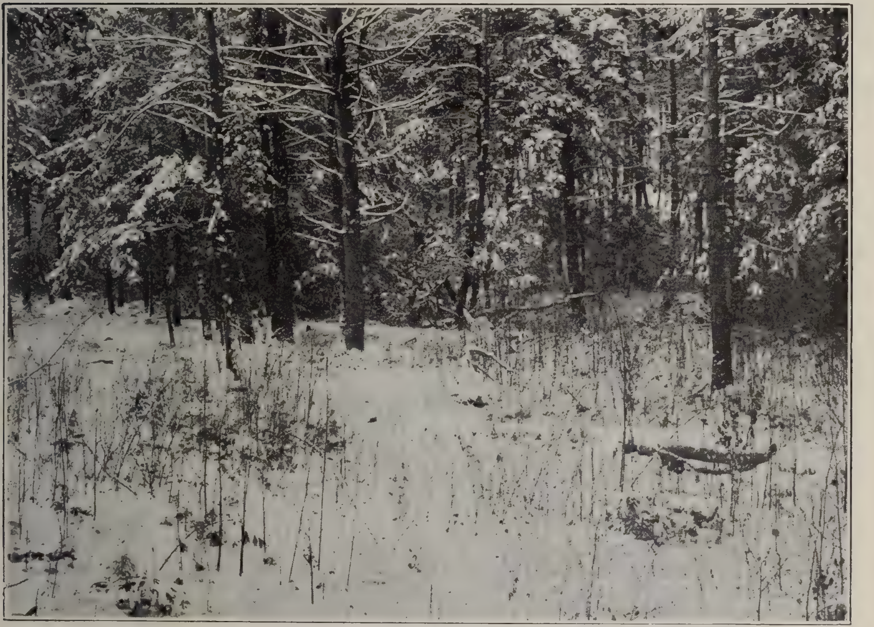

Fig. 18. NATURAL REGENERATION OF THE FOREST.
An opening being filled by a dense growth of White Pine, Tulip, and Hemlock seedlings, from seed scattered by bordering large trees.

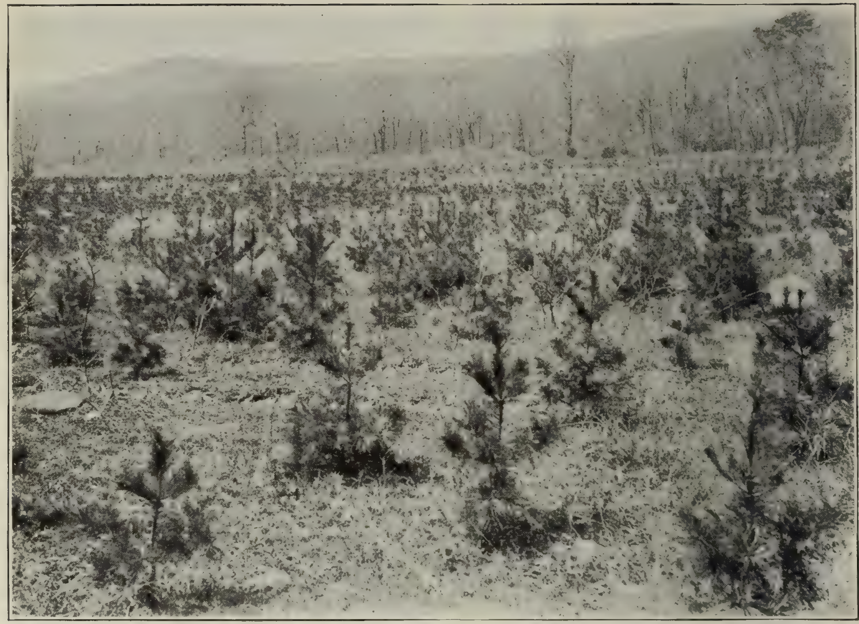

Fig. 19. PLANTATION OF WHITE PINE.
Six years old from seed, about 2,000 trees, 2-3 feet high, per acre.

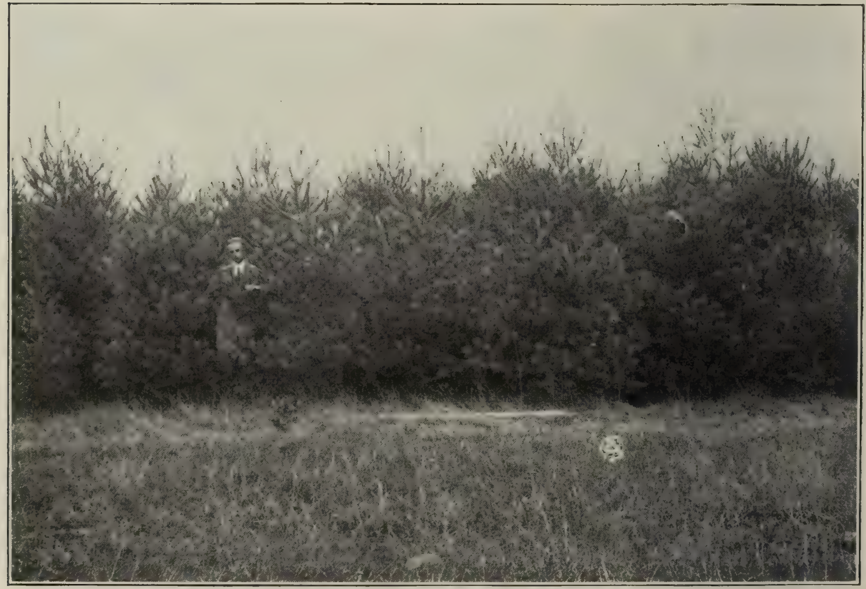

Fig. 20. PLANTATION OF WHITE PINE.
Eleven years old from seed, about 2,500 trees, 5-12 feet high, per acre.

forests which were established artificially are now reaching maturity. Disadvantages of this method are becoming more evident and the foresters are gradually substituting the natural method for the artificial.

The natural regeneration of forests may take place in two ways: (1) By coppice and (2) by seed. By coppice is meant the shoots which spring up from the stump when the tree is cut (Figs. 23, 24, 69, 79) and the suckers which spring up from the roots. Coppicing is a rather important method of reproduction in Pennsylvania since some of our most valuable species, like Chestnut, Ash, and Oak reproduce readily by this method. Natural seed regeneration leaves most of the work to nature. Man attempts to hasten it somewhat by regulated cutting in the stand and by wounding the soil so that the seeds will find a favorable mineral soil upon which to germinate. The trees which produce the seeds may be scattered singly, or occur in groups, in strips, or in opened stands. These trees are known as seed trees or mother trees. Some form of natural regeneration must be used in protection forests, is advisable for game and park forests, and applicable to the forests which are managed for the production of wood. In some cases it is advisable to begin with natural regeneration and then fill in artificially all places which are not stocked with trees.

THE DEVELOPMENT OF THE FOREST.

The raising of some farm crops and the raising of a wood crop have many points in common. A farmer after planting his field to corn in spring does not leave it to nature to develop and mature, but he cultivates it and sometimes even cuts out undesirable sprouts called suckers, knowing that careful tending will result in a larger yield. Likewise the forester is not satisfied in establishing a forest but he also aims to develop or tend it so that it will yield a large and valuable crop.

The method of developing a forest depends upon the nature of the forest and the desire of the owner. The forest may have been established by nature and even partly developed by it or it may have been established by man. The forests established and developed by nature without the aid of man are usually in a rather unsanitary, unattractive, unproductive, and unregulated condition. Under such conditions it is necessary for man to transform these into forests which are clean, attractive, productive, and which show evidence of proper regulation on every hand. The forests which man establishes usually start out with 2,000 to 20,000 or even 50,000 seedlings to the acre, depending upon the method of establishment. If artificial methods of regeneration are used about 2,500 seedlings per acre are required but where natural regeneration is used one may find 20,000 or even 100,000 seedlings per acre. If we go into a mature forest stand and count the trees per acre we will find probably 150, or sometimes 250, and occasionally 400; hence, we must conclude that a large proportion of the trees which start out cannot survive. Two questions suggest themselves: What happens with the large number of trees which cannot mature? Why is it necessary to plant so many when only a small number can mature? If one inspects a plantation of trees a few years after it was established he will be able to note a difference among the trees. Some are thrifty, which is shown by their rapid growth, others are average, while still others show no signs of growth whatever or may have died. If one returns ten years later this condition is still more pronounced. By this time they will have grown to such dimensions that their branches are beginning to interlace. A struggle has started between them. There is no longer sufficient space for all of them. They must battle with each other for light and food. Some will conquer and be known as dominant trees, while others will just about hold their own and be known as intermediate trees, while still others will be conquered and be known as suppressed or dead trees. This struggle for existence is found in all places where trees grow in the form of a forest, and results in the elimination of the weaker specimens. At the same time it gives such drastic discipline to the dominant ones that they will produce a much higher grade of wood. Trees grown in dense stands are usually free from lateral branches for a considerable distance from the ground and as a consequence the logs cut from them will be relatively free from knots; while trees grown in open stands or in open situations bear crowns which often reach almost to the ground and produce numerous knots. Such trees as the latter, consequently, yield an inferior grade of wood.

In developing forests the owner or forester in charge should aim to maintain a proper number of trees per acre and to treat them so that they will not only yield a large quantity but also a good quality of wood. He should not aim to differ from nature's ways of doing things but improve on them. In order to improve the forest it is necessary that the forester carry on certain operations in the immature stand which aim to improve the composition of the stand and the form of the individual trees. He should also aim to increase the rate of growth of the individual trees and as a result increase the yield in volume and value of the final product. The principal operations which one must carry out in order to realize the above objects are: Cleanings, Liberation Cuttings, Thinnings, Damage Cuttings, Pruning, Weeding, and Underplanting.

Cleanings are cutting operations in young rather even-aged stands which remove undesirable trees with little prospective value, and

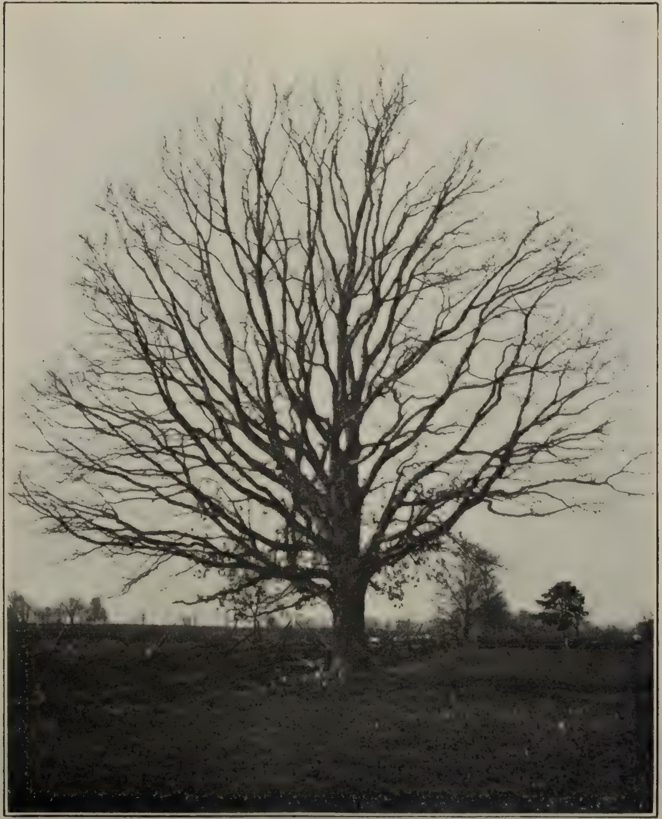

Fig. 21. OPEN GROWN WHITE OAK.
Symmetrical, branches near the base. Will produce considerable cord wood, but little saw timber. Compare forest grown White Oak in Fig. 11.

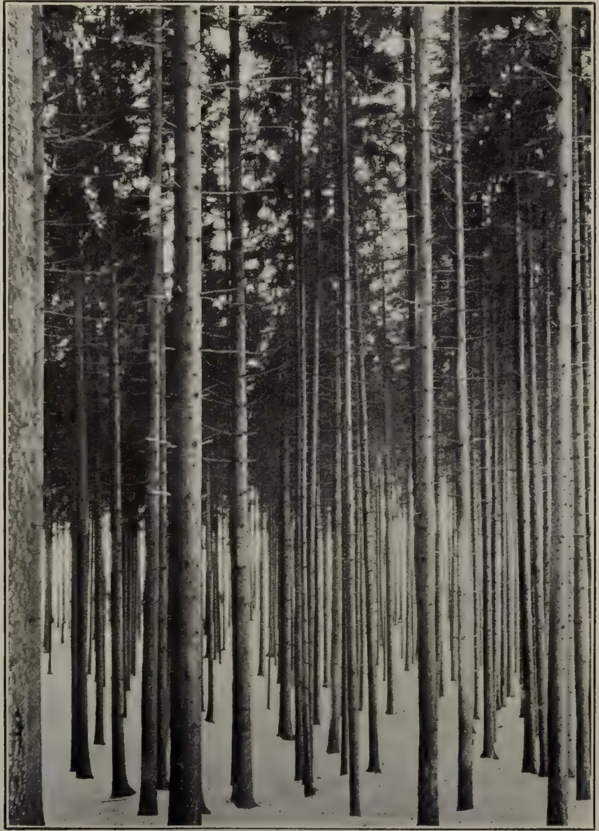

Fig. 22. CLOSED STAND OF SPRUCE.
Crowns shallow, stems clean, little taper, relatively large quantity of high class wood. Pruned by nature.

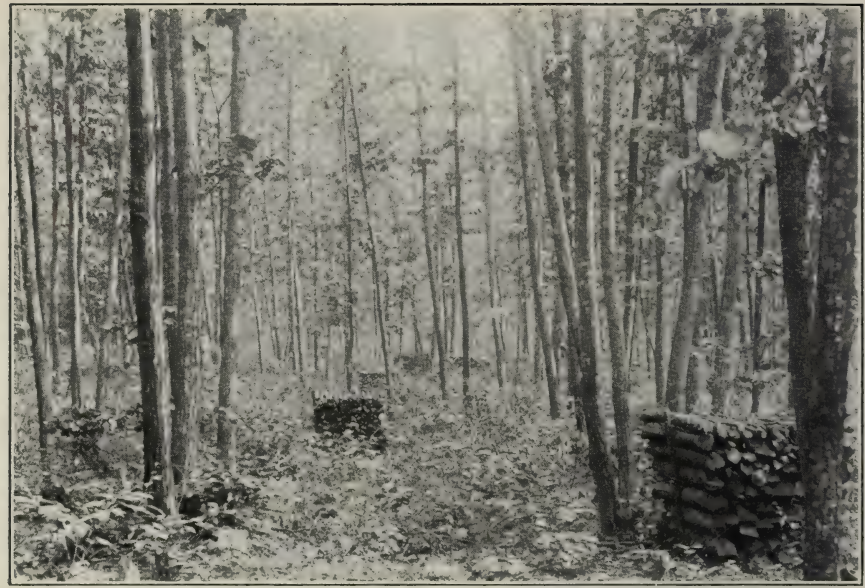

Fig. 23. THINNED CHESTNUT STAND.
About 35 years old. Approximately 280 trees over 4 inches in diameter, breast high, still standing. Eight cords of wood per acre were removed.

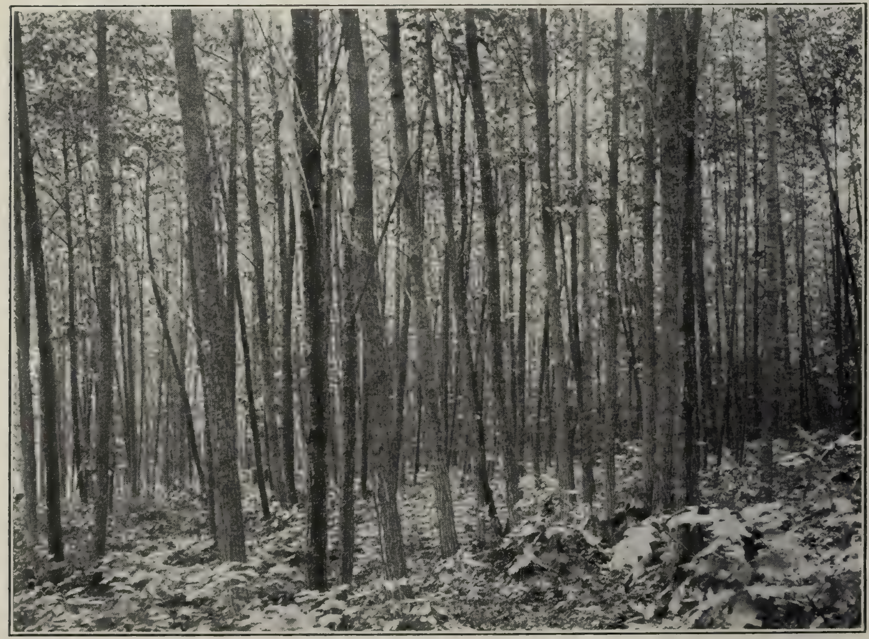

Fig 24. THINNED CHESTNUT STAND.
About 22 years old. Average diameter of trees 5.5 inches. Approximately 650 trees per acre present. Over 90 per cent. Chestnut.

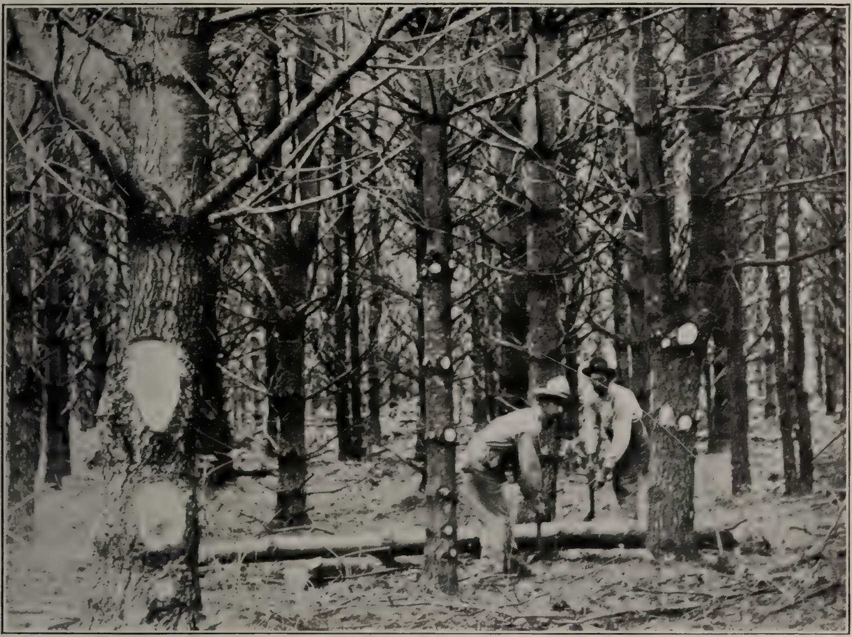

Fig. 25. WHITE PINE STAND BEFORE AND DURING PRUNING.

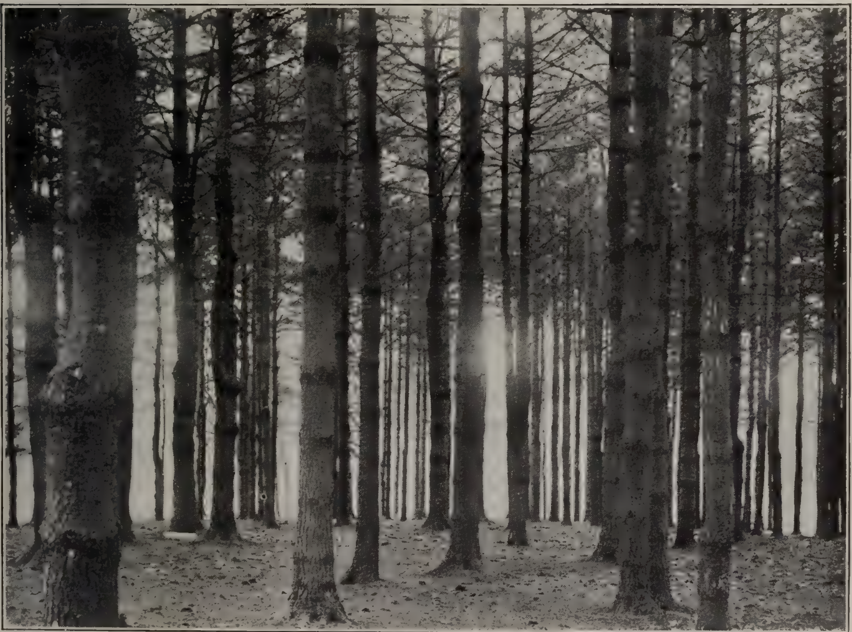

Fig. 26. SAME STAND AS FIG. 25, 10 YEARS AFTER PRUNING.

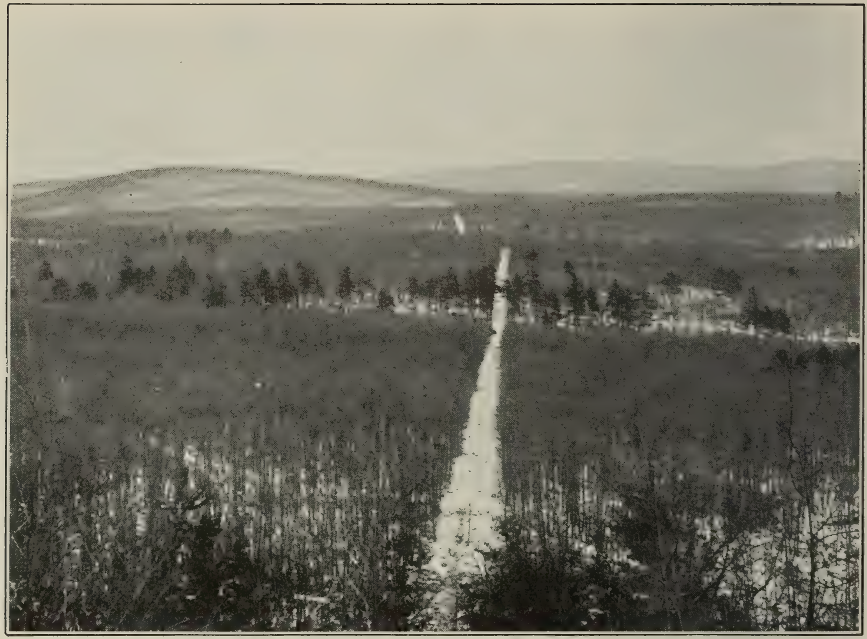

Fig. 27. OIL PIPE LINE AS A FIRE AND SUBDIVISION LINE. A base from which to fight fires. An excellent subdivision line.

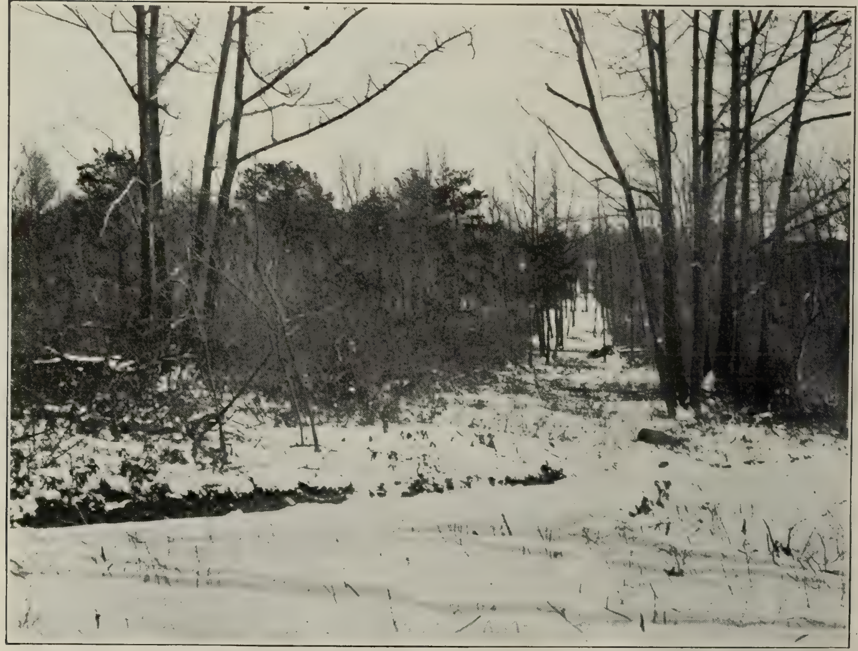

Fig. 28. COMPARTMENT LINE IN A YOUNG CHESTNUT FOREST. Such lines afford a base for controlling fires, and make the forest accessible.

favor other species with a good prospective value. These latter may have been overtopped by the undesirable ones.

Liberation Cuttings are operations in immature stands in which the main crop of trees is overtopped by scattered older trees with very wide-spreading crowns. These older trees with present but little prospective value retard the development of a great number of younger trees with good prospective value. The removal of the larger trees is known as a Liberation Cutting.

Thinnings are cutting operations in immature stands for the purpose of accelerating the growth of individual trees and, as a consequence, increasing the total yield and improving the quality of the product. Thinnings result not only in a larger quantity and quality increment but aim to improve the appearance and health of the forest. They decrease the danger from fire since a large amount of inflammable debris is removed. If thinnings are conducted properly the remaining trees are usually more windfirm. Thinnings also enable one to get returns upon a forest investment without waiting until the crop is finally harvested. Today, under our crude method of regulating the returns from our forests, the thinnings or intermediate yield play a minor role, while the final yield comprises practically the total yield; but as our methods are developed and perfected, the intermediate yields will comprise as in the intensively managed forests of Germany, 25%, and later, 50% of the total yield. All forest owners should aim to improve their forest stands by thinning them properly so that they will become more attractive, more sanitary, and more productive. This may be accomplished by thinning early, regularly, and with increasing intensity, but always cautiously, so that the fertility of the soil will be conserved and all available food properly utilized.

Damage Cuttings comprise operations which remove all damaged material from the forest. The damage may be caused by wind, lightning, snow, insects, fungi, fire, or any of the many other agents which operate in the forest. Damage cuttings should be made as soon as possible after the damage is done not only in order to utilize the material before it depreciates too much in value, but also to prevent the spread of such destructive agents as insects and fungi.

Pruning is an expensive operation and consists mainly in cutting off the lower branches of trees where they were not pruned naturally, in order to produce stems with as few knots as possible and at the same time increase the beauty of the stand.

Underplanting is an intensive cultural operation which is practiced only under systems of intensive management of the forest. It may aim to conserve or even improve the soil or to establish advance reproduction. The aesthetic value of underplanting is also a valuable asset in developing our forest.

Environmental influences and inherent tendencies are factors which are constantly discussed in connection with the development of our youth into useful men and women. These same factors should be considered in developing the young seedlings of the present forest into the veterans of the future.

THE PROTECTION OF THE FOREST.

The protection of the forest surpasses in importance all other forest activities during the early or formative period of forestry in any country. Forest protection is not only the oldest but also the most necessary branch of forestry. Many and varied are the destructive agents at work in the forest or upon the products derived from it. The destructive work of fire is very evident while that of fungi is often hidden. One cannot help but comprehend the destructive work of a forest fire which may sweep over an entire mountain, kill every trace of tree growth, and, in addition, destroy buildings and occasionally human lives; but few even apprehend the extent of damage by such agents as fungi which often cause the decay of the entire interior of a tree without giving any external evidence of their presence. In order to give adequate protection to our forests, it is necessary to know the dangers which threaten them. We must also know how to offset attack by employing preventive and remedial measures. The principal dangers which threaten the forest and against which man must protect it may be grouped as follows:—1. Damage from human agencies. 2. Damage from organic agencies. 3. Damage from inorganic agencies.

Man's disturbing influence in the forest can be comprehended in part when one compares our present forests with those of the past. Primitive man had few wants, but as his civilization progressed his wants multiplied and his destructive tendencies became more apparent. The early settler found it necessary to destroy valuable forests for the purpose of establishing a home and for opening agricultural and grazing lands. He had no alternative then, but now conditions have changed. He is just at the beginning of forest appreciation. He must introduce system and substitute conservative forestry for destructive lumbering, which latter has always been characterized by profligate exploitation and wanton waste.

Man is directly or indirectly responsible for most forest fires, since they usually originate through his carelessness or maliciousness. Lightning is responsible for a very small percentage. Of all the enemies of the forest none is so destructive as fire. A single fire may burn over a few acres only or it may burn over thousands of acres in a single day. It not only destroys present but prospective value, since it consumes or kills mature trees and the young seed-

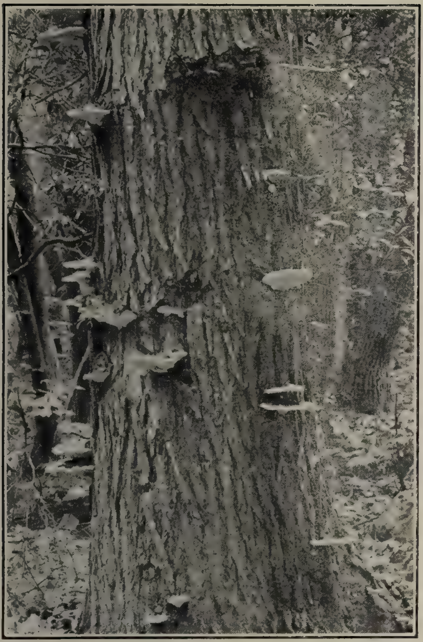

Fig. 29. HEMLOCK TRUNK WITH FRUITING BODIES OF A FUNGUS.

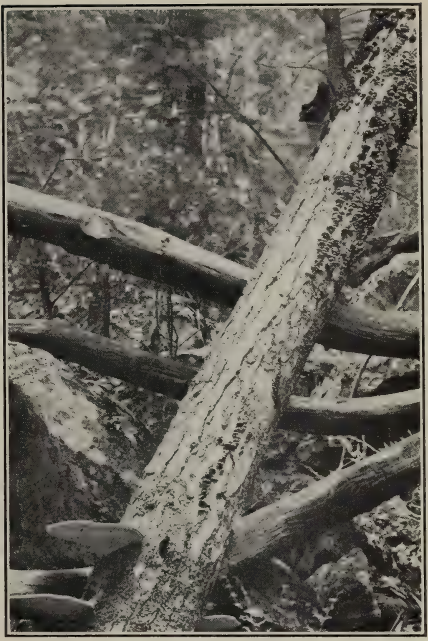

Fig. 30. BLACK BIRCH TRUNK ATTACKED BY TWO DIFFERENT SPECIES OF FUNGI.

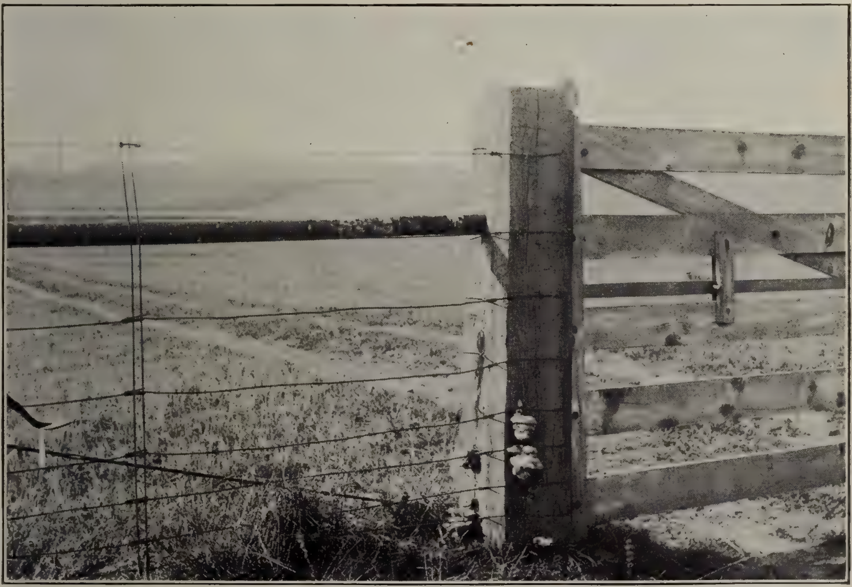

Fig. 31. CHESTNUT POST ATTACKED BY BROWN ROT (POLYPORUS SULPHUREUS).

Some fungi attack only living wood, others attack only dead wood.

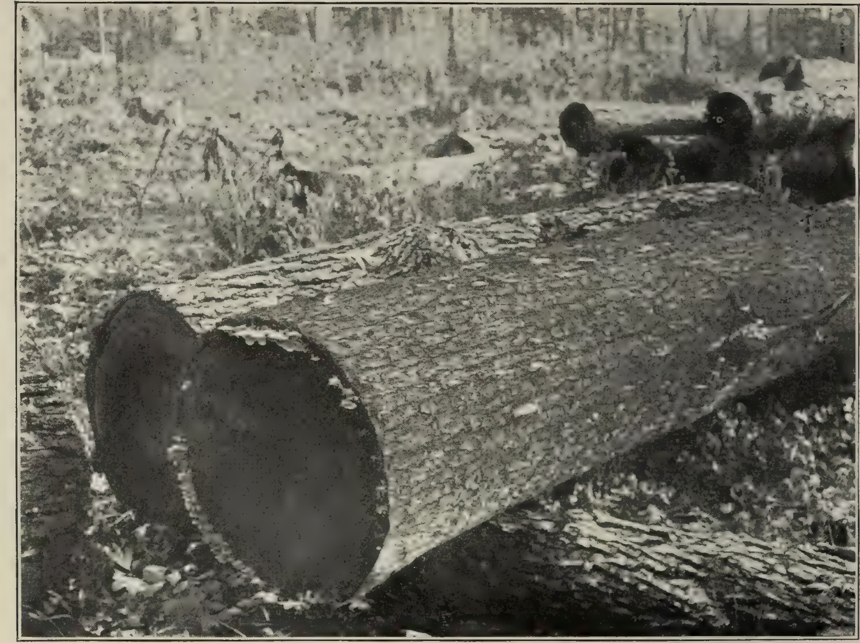

Fig. 32. WHITE OAK AND PINE LOGS ATTACKED BY FUNGI.

The White Oak logs in foreground attacked by 3 different species of fungi. Cut about 8 months before photographing. The value has depreciated with exposure and fungous attack.

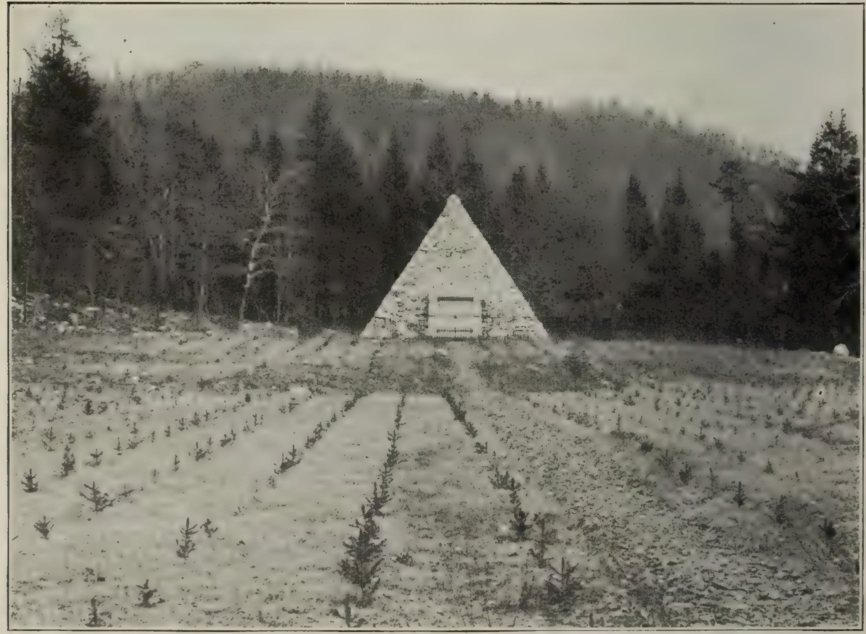

Fig. 33. PRESIDENT JAMES BUCHANAN'S BIRTHPLACE.

Buchanan State Forest, Stony Batter, near Mercersburg, Franklin County. Pyramidal rough stone monument. Norway Spruce in the foreground.

lings and saplings which would have produced the forest of the future. In the years 1907, 1908 and 1909, 2,455 fires occurred in the State of Pennsylvania, and burned over 484,987 acres. The estimated amount of damage was almost $1,000,000. It is also estimated that the average annual direct loss from forest fires within Pennsylvania is $500,000.

Three kinds of forest fires are usually recognized: *Surface fires,* which burn the surface layer of leaves, grass, twigs, and some trees; *Ground fires,* which burn through soils with abundant vegetable material; and *Crown fires,* which burn through the crowns of trees.

Many fires can be prevented by educating the people concerning the real value and significance of the forests. Vigilant patrol during the danger season, the construction of fire-towers, telephone lines, roads, fire-lanes, compartment lines, and the proper disposal of combustible material, help to minimize the fire danger.

The damage which man does in the forest is very noticeable to his fellowman, while that done by other agents often goes unnoticed. Due to the development of our biological sciences in the recent past we are beginning to appreciate the extent of the damage done by such agents as insects and fungi.

The organic agencies which damage the forest are plants or animals. The principal types of plants which do damage to the forest or to the products of the forest are parasitic flowering plants, as the mistletoe, and fungi which cause the decay of wood. The extent of damage which fungi do to trees as well as construction timber is usually underrated. They may be found upon living or dead trees, stumps, logs, railroad ties, and construction timber in bridges, houses and barns (Figs. 29-32). The Chestnut Bark Disease is an example of a parasitic fungous disease which attacks the Chestnut tree, doing enormous damage.

Many different kinds of animals do damage to the forest. Domestic animals, as cattle, sheep, goats, and hogs, and wild vertebrates, as deer, rabbits, squirrels, mice, and beavers, are among the most important damaging agents.

Next to fire, insects are the most destructive enemies of the forest. They may infest young seedlings in the nursery, the fruit or seeds, the twigs, the cambial bark, and the wood. They also do considerable damage by attacking the leaves. Complete defoliation is not uncommon.

The damage from inorganic agents may be in the form of windfall, wind-break, snow-break, excessive cold, excessive heat, shifting-sands, erosion, floods, and noxious gases.

Proper protective measures can sometimes be carried out successfully by the individual, but in other cases the co-operation of the nation, state, or municipality may be required. Organizations or establishments for carrying out protective measures are also required where large areas are to be protected. On July 1, 1914, there were employed in Pennsylvania 56 Foresters and 91 Forest Rangers to look after the 998,773 acres of forest land which the State owns. Most of the foresters employed by the State received their training at the State Forest Academy. By developing the forest fire organization in Pennsylvania, forest fires will be rare events, as in the managed forests of Europe, and if they do break out will cause relatively little damage.

THE VALUE OF FORESTS.

Prior to the time that the conquest of Constantinople closed the route to the Orient, the Atlantic was regarded the world's back door. Columbus, a mere sea captain, to his own surprise, discovered a land which, as the old voyagers related, no one approached without appreciating the beauty of the forest. Those old voyagers appreciated the beauty of the forests but not their prospective value. The forests at first had a negative value. They were something which must be conquered. Their removal was necessary for the establishment of homes and the opening of agricultural lands. Thousands of acres of the best forests were simply burned to get rid of them. They were obstacles in the way of development.

Gradually as our forest acreage decreased, as our population increased, and as the demand for wood goods multiplied, the forests became not only objects of interest and beauty, but also of value. After four centuries of rapid development we are just beginning to comprehend the real importance of our forests. They supply us with wood which is the most indispensable and universally used product of nature. Wood as a necessity or a luxury is used in our various activities from the cradle to the coffin. Many of our houses are built, finished, and heated with wood. Most of the paper upon which we write and upon which our books are printed is made of wood.

The forests supply us not only with wood but with many minor products like maple sugar, tanning materials, naval stores, charcoal, wood alcohol, etc. Artificial silk and even whole suits of clothing have been made from wood. In addition, the forests furnish leaves for stable litter, pasturage for cattle, pannage for swine, and great quantities of nuts which are used as food by man. Pasturage was formerly carried on more extensively than at present. It may be a legitimate industry if it pays and if it is so directed that the young seedlings in the forest, which will produce our future forests, are not eaten or injured. As a rule, grazing should not be permitted in young forests where the shoots are still tender and readily eaten by animals, nor where the grazing animals may tramp out the seedlings.

The original forest may be regarded a great reservoir of wealth filled by nature working through many centuries, and exploited by man either for its products or to establish in its place a more necessary industry. The present forest on the other hand may be represented by a much smaller reservoir only partly filled, and with material which is inferior not only to that found in the original forest but also far inferior to that which we hope to develop in the future forest. The present forest if properly managed, which implies improvement, is capable of producing continuously a large quantity of major and minor forest products representing an enormous value. In addition to the usual monetary value of forests we should also consider their value as soil formers, soil fixers, soil improvers, preventers of floods, sanitary agents, suppliers of natural blessings, and beautifiers of the earth.

THE VALUE OF TREES.

Trees are among the commonest and most conspicuous objects of nature. They vary considerably depending upon their kind, their environment, and the artificial treatment which they may have received during their development. The trees which surrounded the simple home of the early pioneer differed very much from those which adorn the grounds of some of our wealthy citizens today, showing that nature, unaided by man produces trees in the forests which differ considerably from those which man has planted and cared for. Environment is a very potent factor which not only influences the general appearance of a tree but also the structural parts which compose it. Trees as members of the forest stand have been considered in the preceding chapter. The subjoined material treats of trees used for purposes other than forestry.

Trees are not only valuable for their products, as wood, resin, fruit, and litter, but in addition have an aesthetic and a protective value. Although tree-planting for shade and ornament has been practiced assiduously in past generations, yet the value of such planting and the care which such trees require and should receive has not been fully appreciated until lately. Today individual trees or small groups of them are planted rather extensively about homes, along streets, in parks and public squares, for their shade and shelter. They are also used about the home to screen objectionable objects, to direct and restrict the views along general lines, to frame the home picture and to give the surroundings the expression of comfort and homeliness.

The establishment and care of shade and ornamental trees is entirely different from the care of forest trees. Knowledge concerning the life-history of trees in general is, however, a prerequisite for the proper treatment of both classes of trees, but the art by which this knowledge is applied is entirely different. The forester grows trees to harvest and at harvest time he aims to obtain from them as much and as high grade wood as possible. The tree warden grows trees to preserve. He aims to develop a tree with as desirable an appearance as possible and to retain it as long as the vitality of the tree will permit.

Thousands of dollars are spent annually by shade and park commissions in developing the aesthetic side of our cities, towns, and many of our rural districts. The commissions or individuals who have this in charge, aim, by beautifying the environments, not only to improve the health and efficiency of the citizens, but also to raise their moral standard and hence increase their social worth.

DECIDUOUS AND EVERGREEN TREES.

All trees native to the State of Pennsylvania, when in a healthy condition, bear green foliage in summer. In autumn many of the green leaves change to brilliant colors, yellow, scarlet, deep red, or purple, and gradually fall to the ground. The species of trees whose leaves lose their green color and fall in autumn are known as *deciduous trees.* Most of the trees native to the State of Pennsylvania are deciduous. The deciduous trees are also known as hardwoods or broad-leaf trees. The Oaks, Maples, Birches, and Chestnut are common examples of this group. Many of the representatives in this group yield valuable products and furnish interesting objects of study on account of their variation in form. In winter the deciduous trees are far more conspicuous than in summer since the dense leaf canopy is absent. This affords an opportunity to study the trees with special reference to their form, branching, and bark. These characters are among the most helpful in distinguishing our common trees, especially since they are at hand at all seasons of the year. The leaves of a few deciduous species like the Beech and some of the Oaks die in autumn but often persist through the winter.

Some species, however, do not shed all of their leaves in fall. Such trees are known as *evergreen trees.* The evergreen habit is characteristic for most trees commonly known as conifers. Most of the conifers have needle-shaped leaves which persist for two or more years. The Larch, native to this State, and the introduced Bald Cypress are, however, two species which shed all their leaves in fall and during the winter appear like dead conifers. The persistence of the foliage of most of the conifers enriches the winter scenery and affords shelter for birds and other animals. Many conifers are highly prized for ornamental purposes and some yield valuable commercial products. The Pines, Spruces, Firs, Cedars, and Hemlocks are the commonest examples of this group. In addition to the conifers a few broad-leaf species, such as Rhododendron, Mountain Laurel, and American Holly, are evergreen. A transition from the evergreen to the deciduous habit may be found in the Deciduous Holly and the Laurel Magnolia which are deciduous in the northern and evergreen in the southern states.

The deciduous trees are commonest in the eastern part of North America while the evergreen are commonest in the western part. The former are usually found in mixed stands, while the latter often occur in extensive pure stands. The hardwood species usually occur on rather fertile soils while the conifers may thrive on more sterile ones. Both the deciduous and the evergreen habits have their advantages. The shedding of the leaves in fall is a protective adaptation since it reduces transpiration, danger from snow-break, and damage from noxious gases. The evergreen trees have the advantage of lower summer transpiration and are ready at any season of the year for constructive activity. They are also less subject to damage by frost during the growing season. The advent of forestry may change the structure and distribution of our forests. The present tendency seems to be gradually and cumulatively in favor of the conifers.

THE AGE OF TREES.

Some trees reach great size and enormous age while others remain small and die young. The size and age which a tree attains depend upon the inherent tendency of the species and the factors of the environment. Some species which naturally grow tall and become old may remain small under unnatural and unfavorable growth conditions. Other species never become large and old even under the most favorable growth conditions since it is inborn in them to remain small. A definite age limit cannot be fixed for each species but for general convenience we may classify our common trees as short-lived or long-lived. Of the trees native to the State of Pennsylvania the Oaks, Chestnut, Buttonwood, Tulip Tree, White Pine, and Hemlock may be regarded as long-lived trees, and the Poplars, Willows, most Birches, and some Cherries as short-lived. Some of the White Oaks found in the original forest of Pennsylvania showed an age of approximately 500 years. Some of the trees of this State reach a great age and enormous size, still none approach such trees as the Big Cypress Tree of Tule found in the state of Oaxaca, Mexico, or the Sequoia of California.

It is not always easy to tell the age of a tree or that of an even-aged stand of trees. Planting records are often very valuable in determining their exact age. The best means of finding out the exact age of a tree is to ask the owner who kept a record when the tree was planted. This method may be used for some ornamental trees and for forest stands which were artificially established. Detailed records should be kept of all forest stands whether established artificially or naturally. The determination of the age of trees in the original forest or in an unregulated forest is a more difficult task. The age of a young tree like that of a child is more readily determined than that of an old tree. The best test for telling the age of a tree, if planting records are wanting, is to count the annual rings on a cross-section of the stem near to the ground and adding to this number, as many years as it took the tree to grow to that height. (Plate I, two lower series of drawings, and Plate XI, 1, 3). Each ring usually represents the growth of one year. A second test will apply to such species as White Pine, which develop their lateral branches in distinct and rather regular whorls. (Plate I, upper right figure, and Fig. 19). Each whorl normally represents a year's growth. If the branches have fallen off one can often find the scars of the branches on the stem. (See Frontispiece and Figs. 25 and 26). The age of young trees or small branches can also be determined by counting the rings of terminal bud-scale scars (Plate I, upper left figure). The portion of the branchlet from the end down to the first ring of bud-scale scars represents the last season's growth while that between the first and second rings represents the next to the last season's growth and so on. To tell the age of trees may sometimes be difficult but it is usually fascinating. After you have been successful in determining the age of a few trees, you may find yourself questioning the age of others as you walk or drive by them. A careful study of their growth will often indicate the successes and failures which they met during their development, since a relatively narrow ring often indicates a struggle, while a wide ring often indicates favorable growth conditions.

THE FORM AND STRUCTURE OF TREES.

1. Form:

By form is meant the general appearance of a tree. One can study the form of deciduous or broad-leaved trees best in winter when they are devoid of their foliage. After one is familiar with the general form of different trees it is possible to distinguish the different species even at a great distance. The form, together with

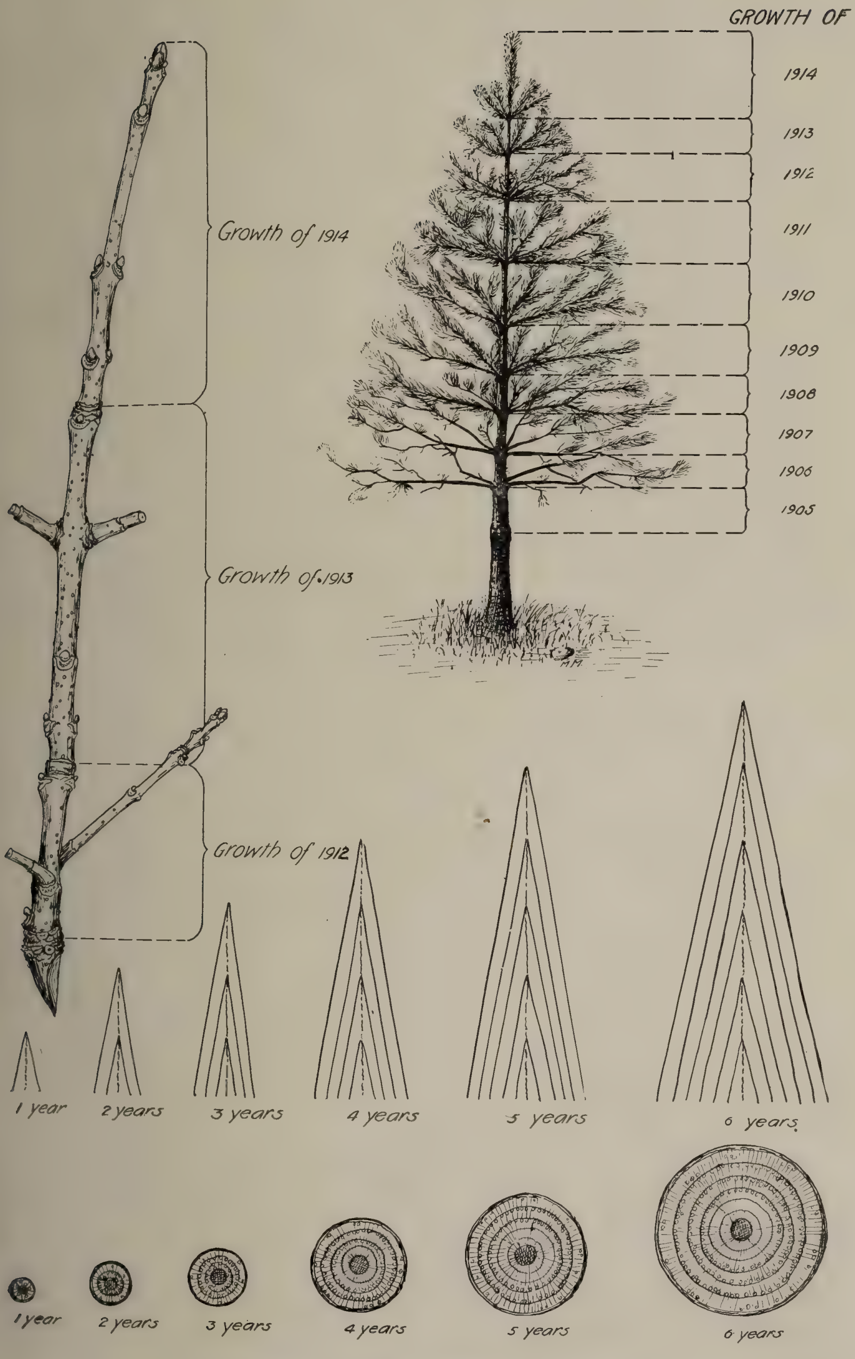

PLATE I. THE AGE OF TREES.

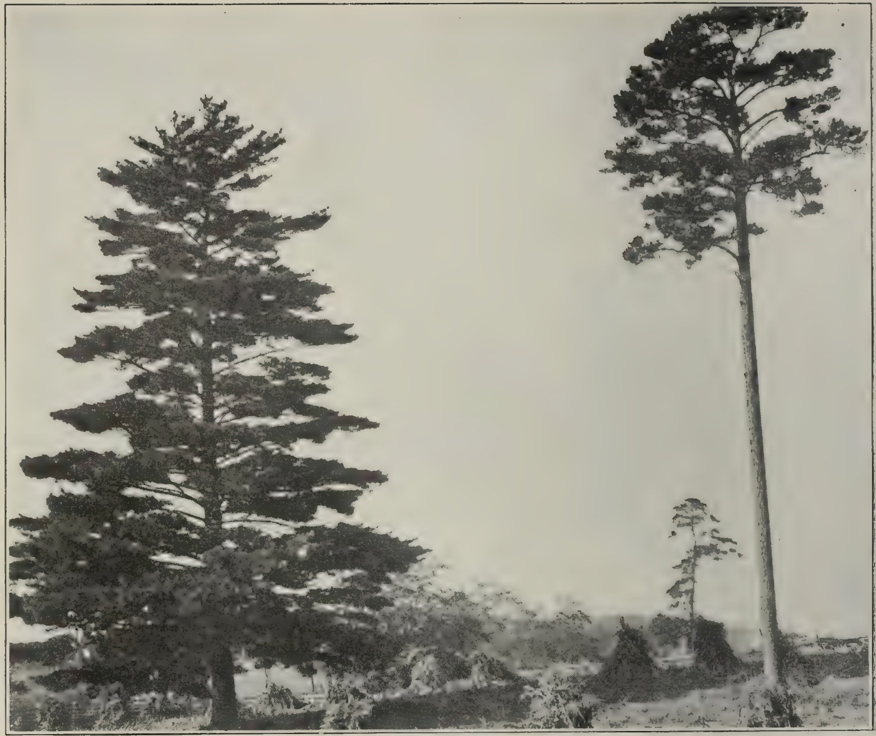

Fig. 34. OPEN GROWN PINES.

White on left, Yellow on right. Both trunks excurrent and developed in same environment. Difference of form is due to inherent qualities. One tapers, with persistent lateral branches; the other with little taper and few branches.

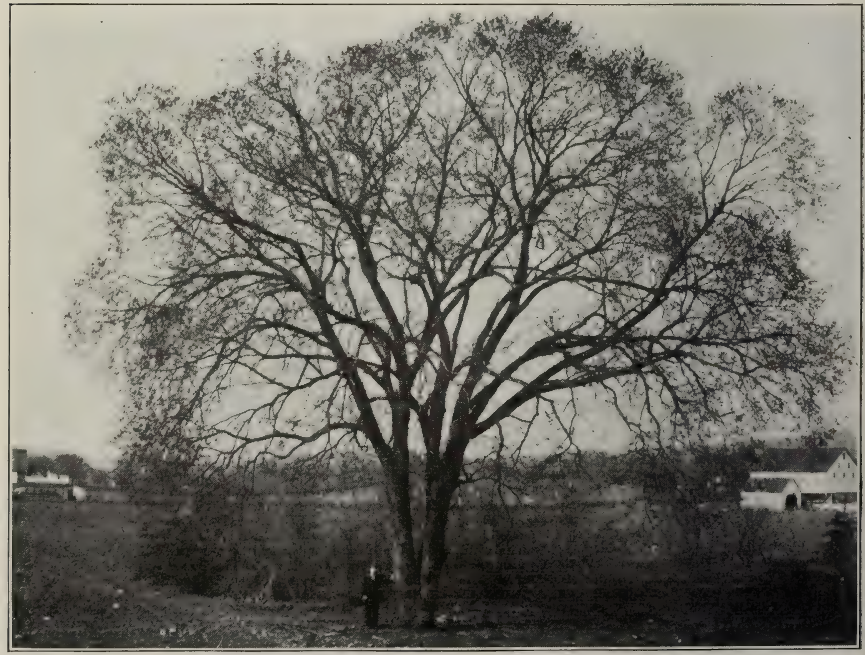

Fig. 35. OPEN GROWN AMERICAN ELM.

Its trunk branches near the base and then repeatedly subdivides. Such a trunk is known as a deliquescent trunk.

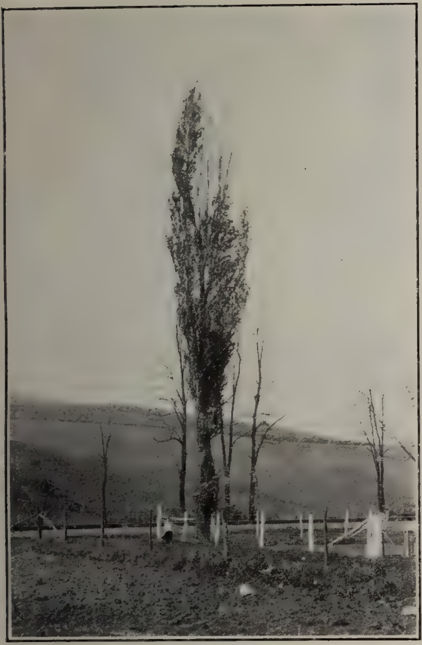

Fig. 36. FORM OF LOMBARDY POPLAR.

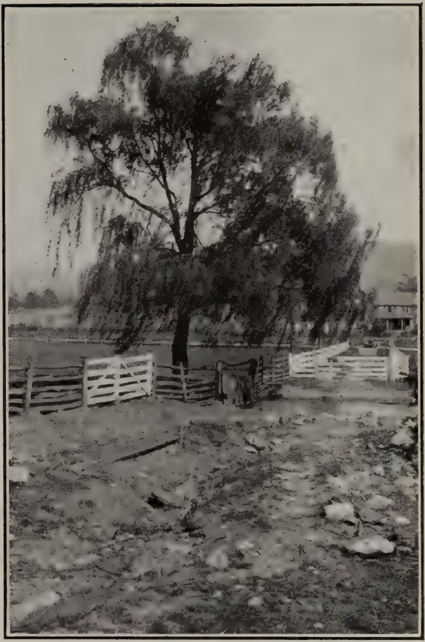

Fig. 37. FORM OF WEEPING WILLOW.

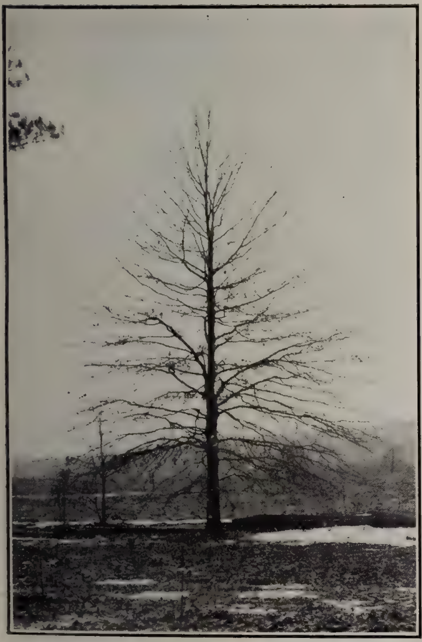

Fig. 38. FORM OF A YOUNG PIN OAK.

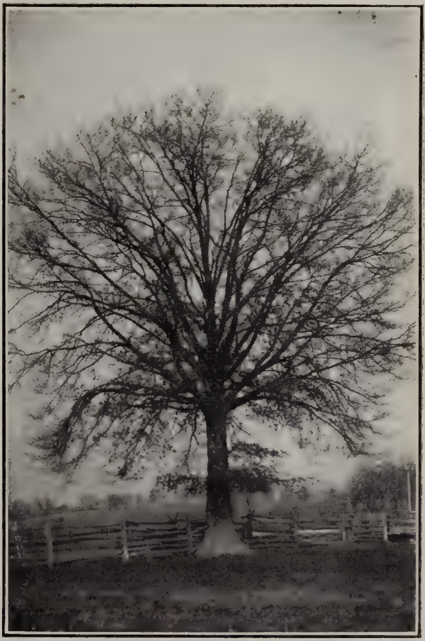

Fig. 39. FORM OF AN OLD PIN OAK.

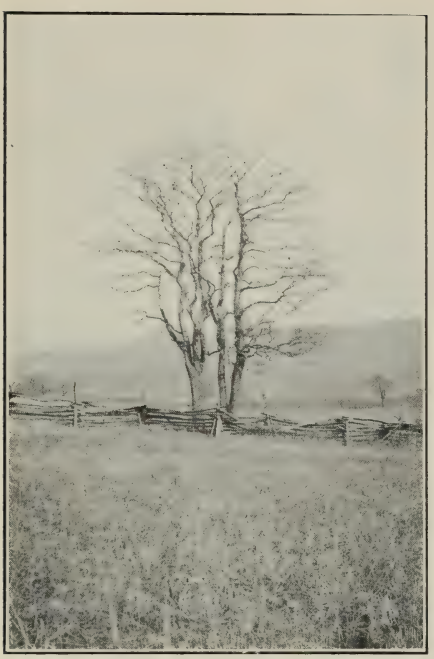

Fig. 40. FORM OF A SASSAFRAS.

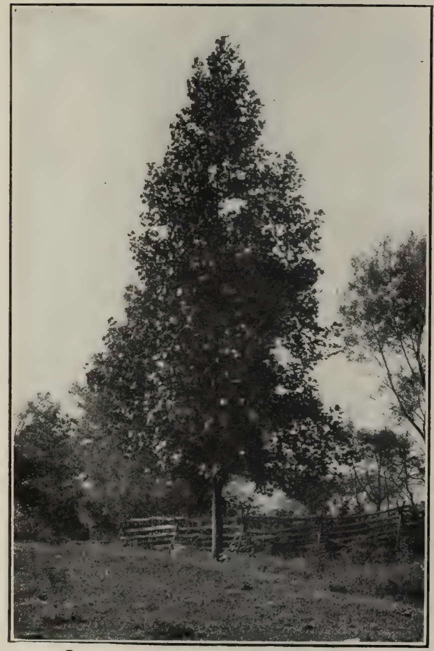

Fig. 41. FORM OF A YOUNG OPEN GROWN TULIP TREE.

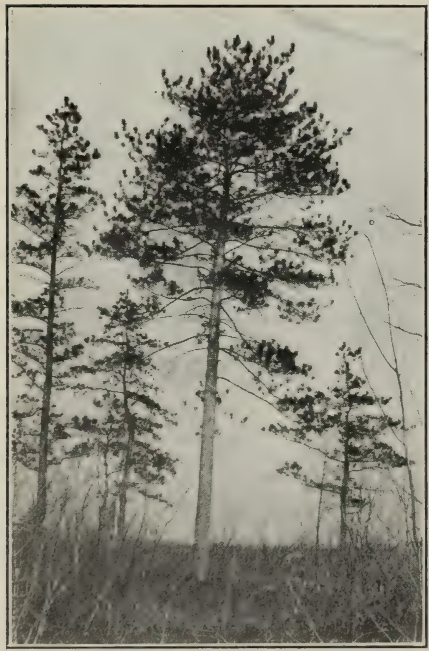

Fig. 42. FORM OF A RED PINE.

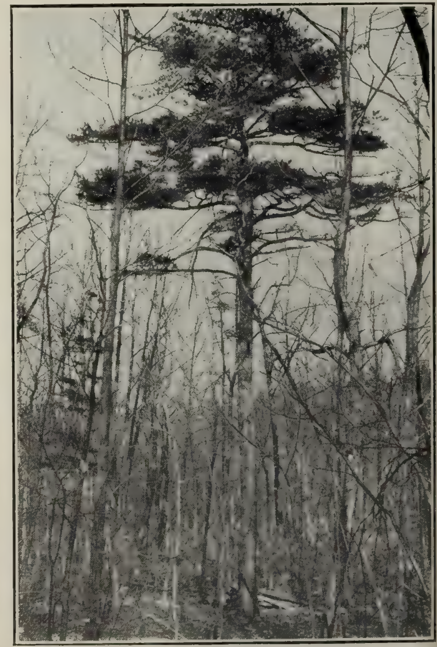

Fig. 43. FORM OF A TABLE MOUNTAIN PINE.

It developed in a closed stand. Diameter 22 inches.

the color and figure of the bark, is a character by which many of our trees may be accurately distinguished. The form of trees varies with the species, the environment, and the sylvicultural treatment.

Some trees attain an enormous size and great age while others never become large or old. The Sequoias of California, also known as Redwoods and Big Trees, and the Cypress trees of Mexico have representatives which are regarded the largest and oldest in existence. A section of a Big Tree now in the American Museum of Natural History in New York City shows that the tree when cut was 1,341 years old. It was 90 feet in circumference at the base, over 350 feet in height, and estimated by lumbermen to contain 400,000 board feet of lumber. Probably the largest Cypress tree in the world stands in a churchyard about five miles from the City of Oaxaca in Mexico. This tree has a circumference, according to recent measurements, of 154 feet 2 inches, 6 feet above the ground. It is about 125 feet high and, according to various estimators, can scarcely be less than 4,000 years old, and may possibly be over 5,000 years. Specimens of this size and age have never been found in the State of Pennsylvania. Some of our native trees, the Chestnut, White Oak, Red Oak, Tulip Tree, Hemlock, and White Pine have, however, attained great size. A few large specimens which were cut in recent years, showed by count of their annual rings that they had started life before Columbus discovered America. In Forest Leaves, Vol. IX, No. 10, Dr. J. T. Rothrock describes a White Oak standing near Kutztown, Berks county. It was 31 feet in circumference at the level of the ground and had a spread of branches of 104 feet and an estimated height of almost 74 feet. This tree was probably the largest of this species in Pennsylvania. Larger specimens of Chestnut have been found in this State. The largest Chestnut tree on record had a diameter of 17 feet. It was found near Waynesville, North Carolina. Other species like the Scrub Oak (Fig. 4), Gray Birch (Figs. 64 and 69), and Scrub Pine never become large. Some species may remain small in one region and yet become large in another. The Chinquapin which reaches its northern limit in Pennsylvania seldom exceeds a height of 10 feet in this State while it reaches a height of 50 feet in southern Arkansas.

The character of the stem, to a large extent, determines the form of the tree. The main axis of a tree usually grows erect. The lateral branches vary according to the species and the position of neighboring branches. In some species like the Weeping Willow (Fig. 37) they are drooping, in others like the Black Gum and Pin Oak (Fig. 38) they are horizontal, while those of the Lombardy Poplar are ascending (Fig. 36). If the terminal shoot is removed or killed a lateral branch in time may take its place. Sometimes two lateral branches strive for the leadership but they are such close competitors that neither can win out. The result is a "stag-headed" tree. Again a dormant bud may be stimulated into activity with the result that no lateral branch obtains the leadership. After studying these growth forms, one is inclined to think that the terminal shoot prevents the erect growth of the lateral branches.

Environment has a marked influence. The form of a tree growing on an exposed mountain top differs very much from one growing on sheltered bottomland. An open grown tree has a form entirely different from one grown in dense forest stand. The form of open grown specimens varies with the species. Two different species of Pine shown in Fig. 34 grew side by side in the same environment and still developed entirely different crowns. Open grown trees usually branch near the ground and have a broad, deep, symmetrical crown, while trees grown in dense forest stand usually branch farther from the ground and have a long clean trunk with a shallow and often irregular and unsymmetrical crown. Trees grown in a dense stand may not be so attractive as those grown in the open but they yield a much higher grade of wood, since the lateral branches which produce many of the knots in lumber are removed early in the life history of the tree. The density of the forest stand should be so regulated that on every acre of soil not only the greatest quantity but also the best quality of wood is produced.

Two kinds of branching are usually recognized, the *excurrent* or upright and the *deliquescent* or spreading. When the main trunk is continuous and extends upward to the tip without dividing it is known as excurrent, and when the main trunk is not continuous but divides and subdivides into more or less equal parts it is known as deliquescent. Most of our evergreen species have the excurrent type of branching, while most of our deciduous trees have the deliquescent type. A few of the latter, as the Pin Oak, Tulip Tree, and Buttonwood, often show an excurrent or upright tendency in the form of their trunk, especially when young.

2. BARK:

If we examine the growing point of a seedling we will find that there is very little difference among the parts composing it. Soon, as a result of growth, various kinds of tissue will be formed. At the end of its first growing season we can differentiate roots, stem, and leaves. The stem is still further distinguished into pith, wood, and bark (Plate XI, 1.) Nature seems to know that the vital elements in the stem need protection. This protection is given by the bark.

Bark is that portion of the stem which lies outside of the cambium layer. It consists of an outer and an inner part. The former is commonly known as the outer or dry bark and functions primarily

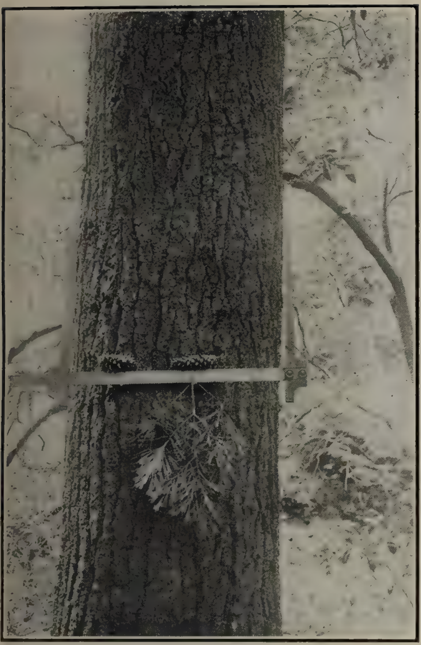

Fig. 44. WHITE PINE.
Trunk 25 inches in diameter.

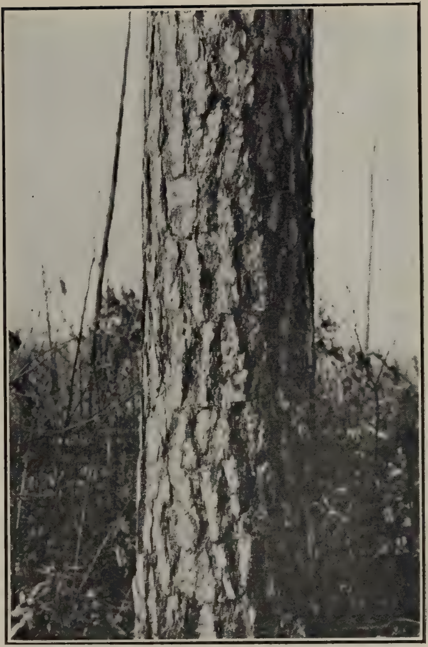

Fig. 45. RED PINE.
Trunk 20 inches in diameter.

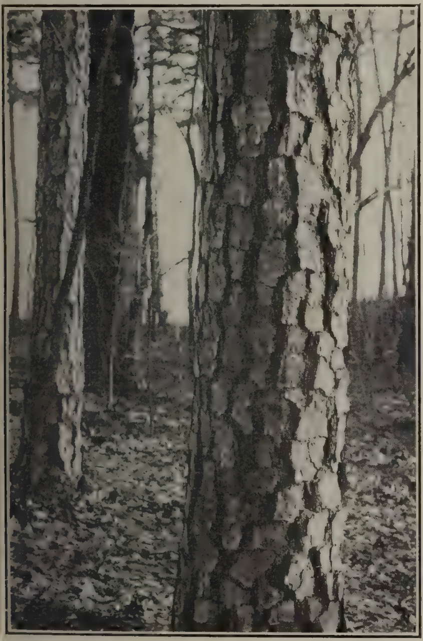

Fig. 46. PITCH PINE.
Trunk 22 inches in diameter.

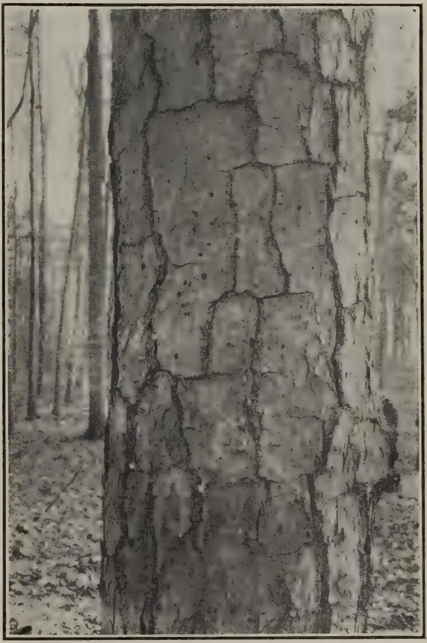

Fig. 47. YELLOW PINE.
Trunk 29 inches in diameter.

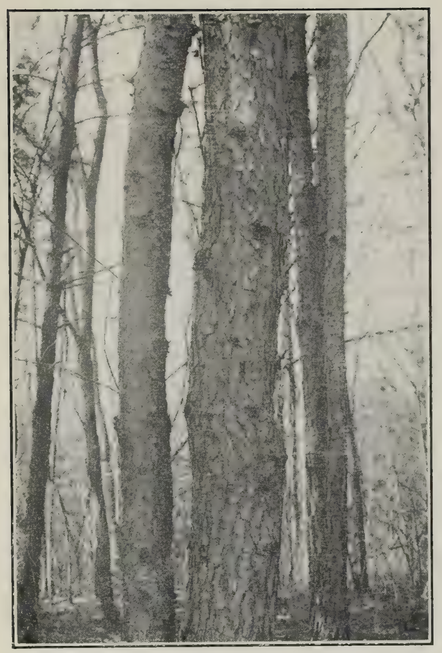

Fig. 48. JERSEY OR SCRUB PINE.
Trunks 7 and 14 inches in diameter.

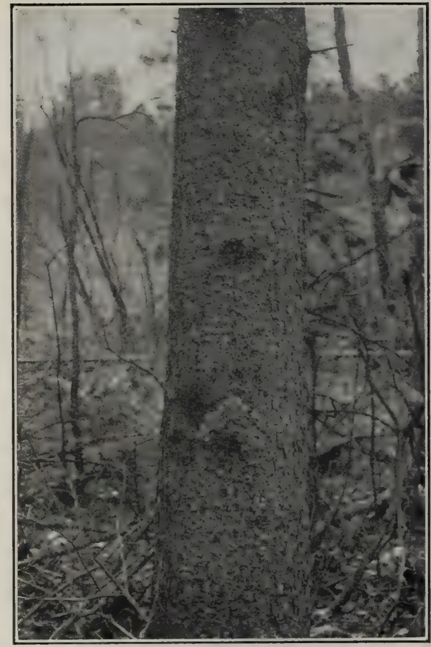

Fig. 49. AMERICAN LARCH.
Trunk 18 inches in diameter.

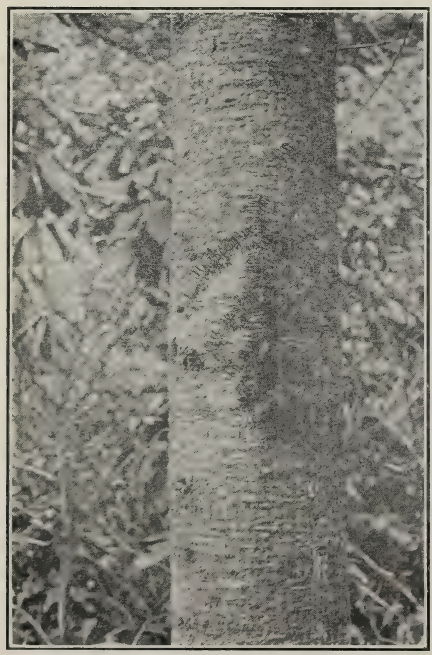

Fig. 50. BALSAM FIR.
Trunk 16 inches in diameter.

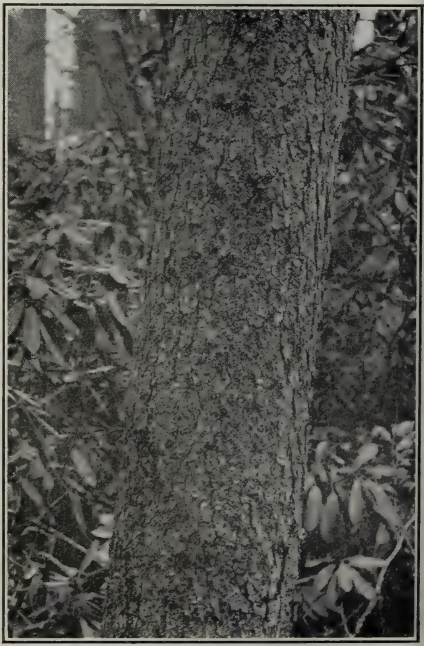

Fig. 51. BLACK SPRUCE.
Trunk 14 inches in diameter.

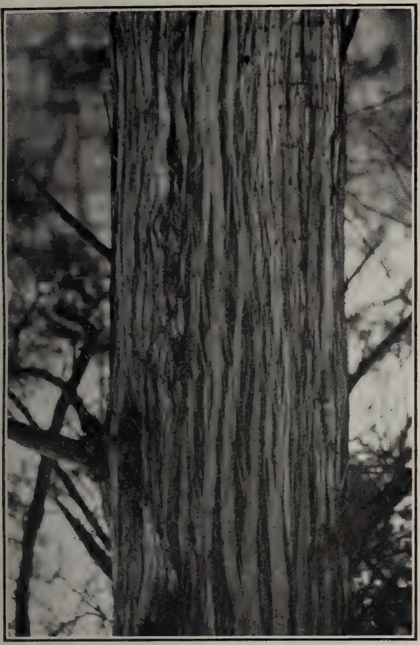

Fig. 52. RED CEDAR.
Trunk 24 inches in diameter.

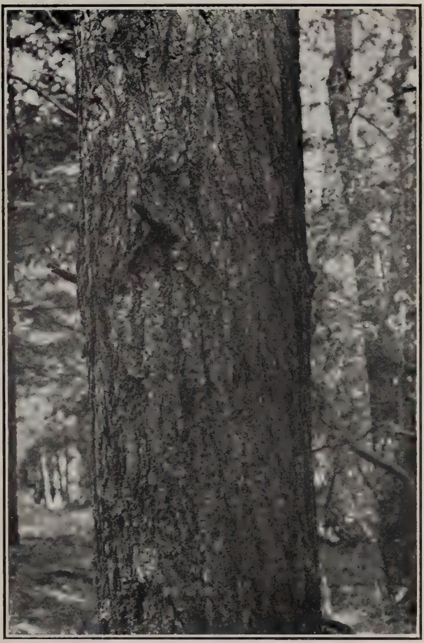

Fig. 53. HEMLOCK.
Trunk 22 inches in diameter.

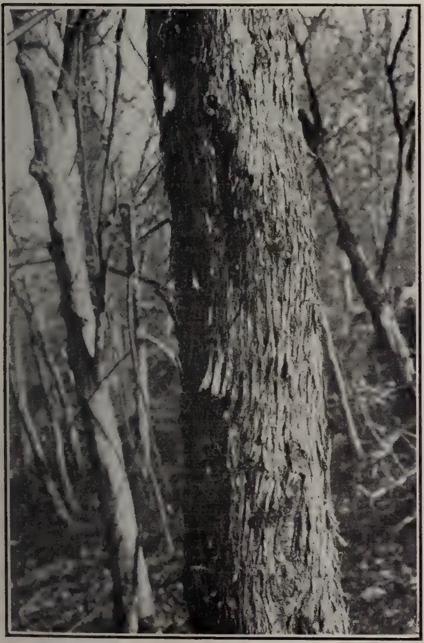

Fig. 54. AMERICAN HOP HORNBEAM.
Trunk 18 inches in diameter.

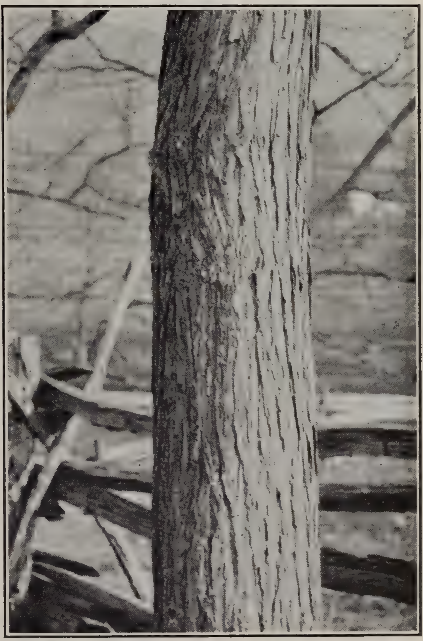

Fig. 55. RED MULBERRY.
Trunk 17 inches in diameter.

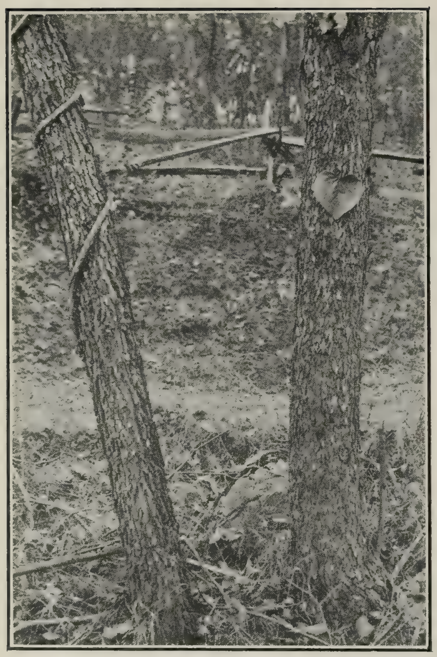

Fig. 56. REDBUD.
Trunk 8 inches in diameter.

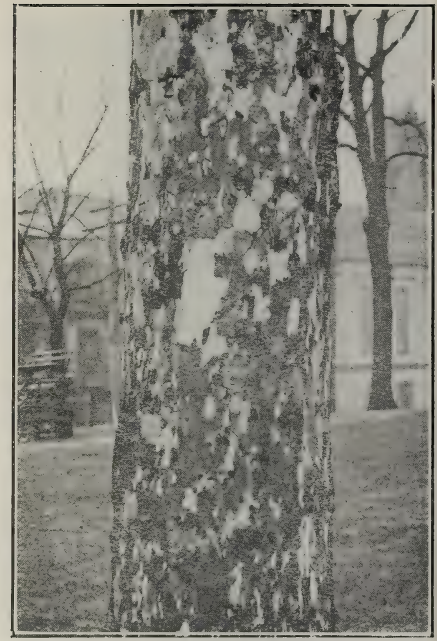

Fig. 57. BUTTONWOOD.
Trunk 18 inches in diameter.

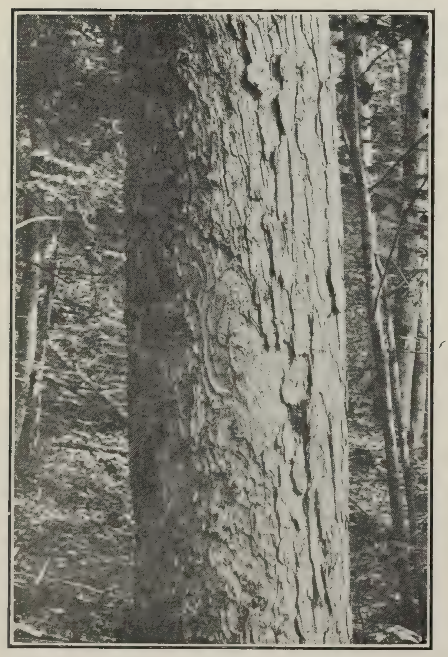

Fig. 58. SWEET BUCKEYE.
Trunk 32 inches in diameter.

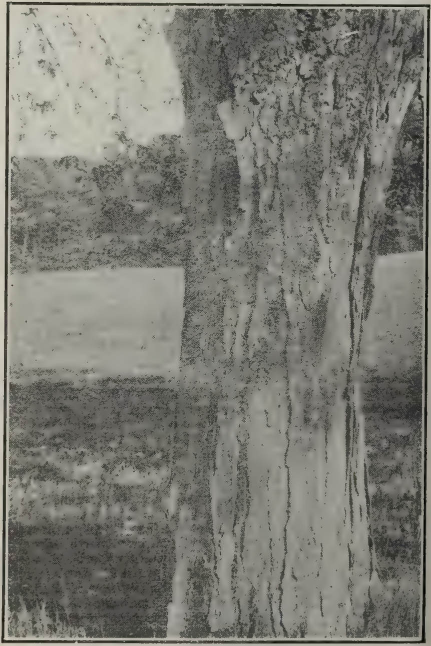

Fig. 59. HONEY LOCUST.
Trunk 30 inches in diameter.

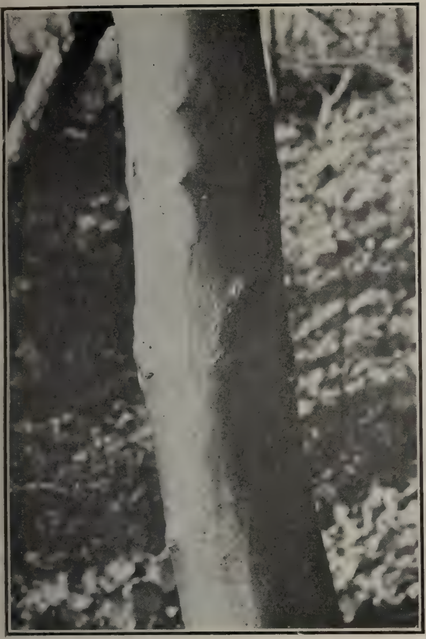

Fig. 60. RED MAPLE.
Trunk 8 inches in diameter

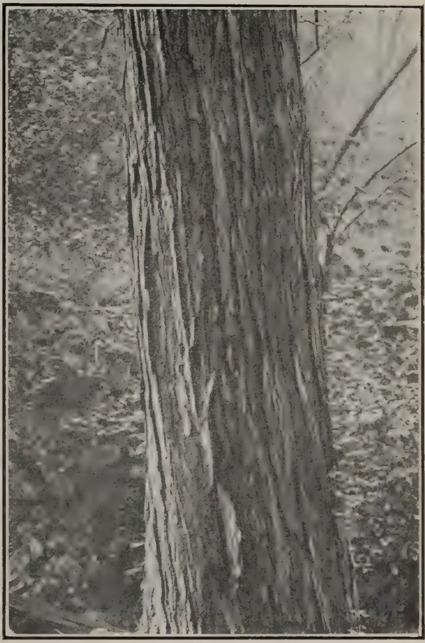

Fig. 61. RED MAPLE.
Trunk 30 inches in diameter.

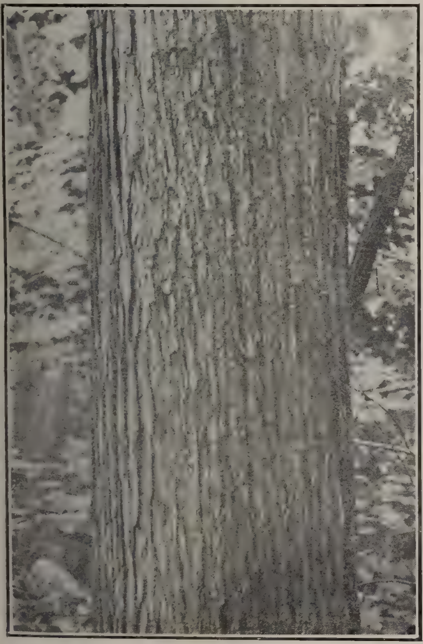

Fig. 62. SUGAR MAPLE.
Trunk 32 inches in diameter.

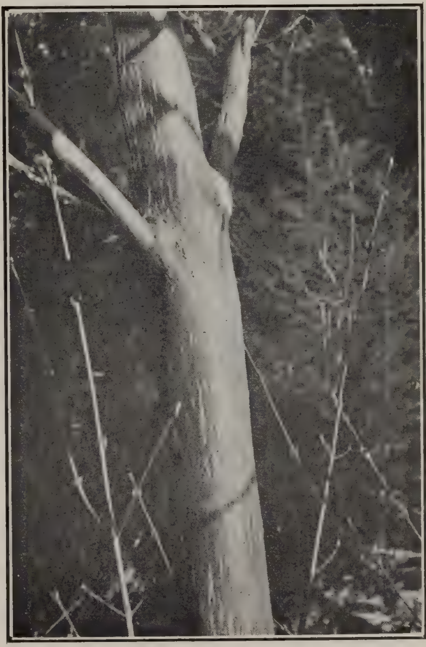

Fig. 63. STRIPED MAPLE.
Trunk 4 inches in diameter.

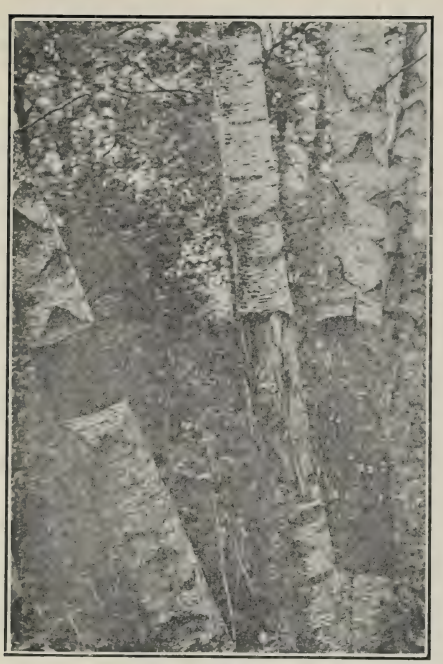

Fig. 64. GRAY BIRCH.
Trunk 4-9 inches in diameter.

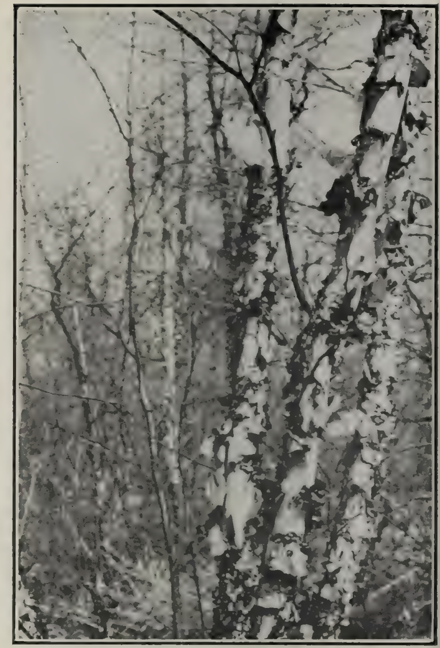

Fig. 65. RIVER BIRCH.
Trunks 6 inches in diameter.

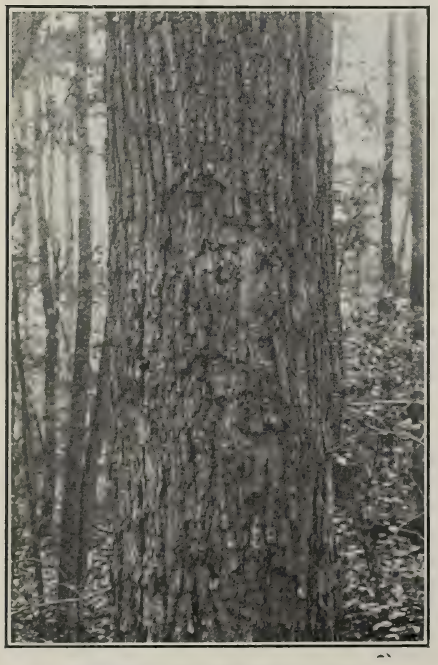

Fig. 66. SLIPPERY ELM.
Trunk 26 inches in diameter.

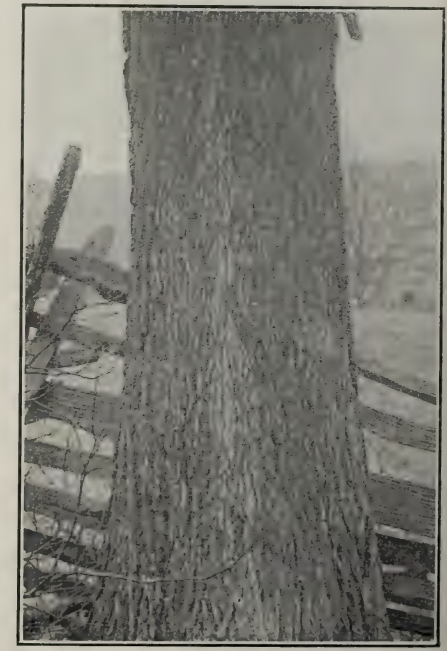

Fig. 67. SASSAFRAS.
Trunk 26 inches in diameter.

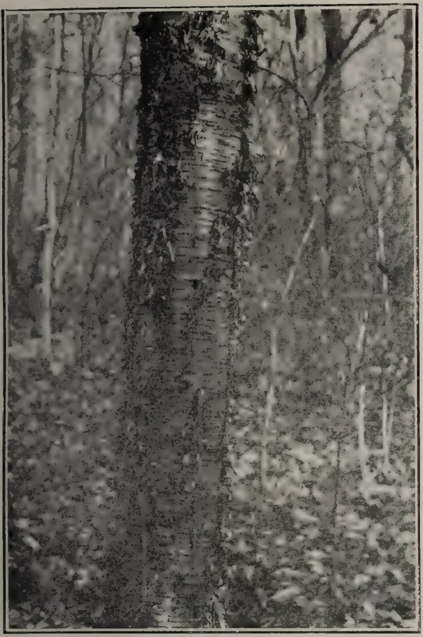

Fig. 68. YELLOW BIRCH.
Trunk 8 inches in diameter.

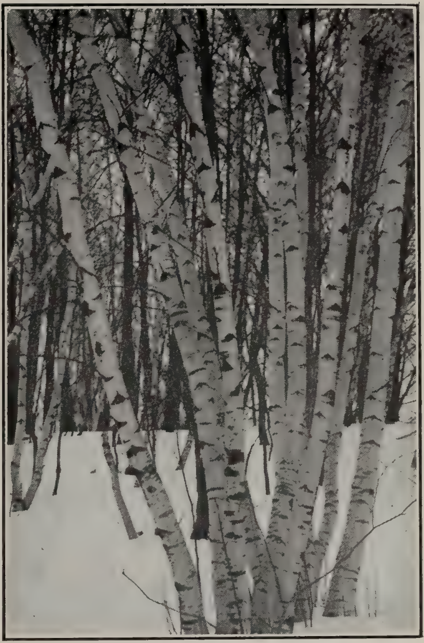

Fig. 69. GRAY BIRCH.
Trunk 4 inches in diameter.

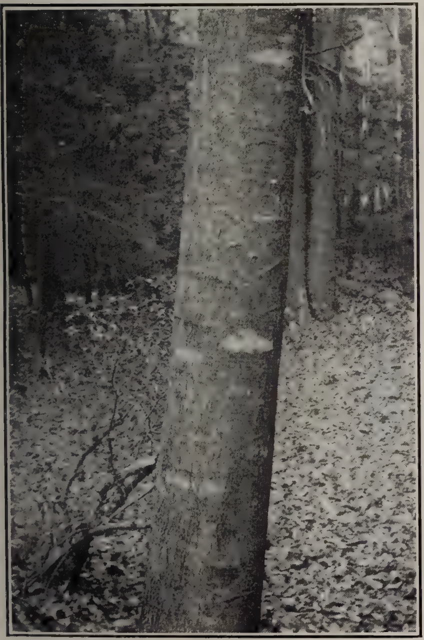

Fig. 70. BLACK BIRCH (Young.)
Trunk 7 inches in diameter.

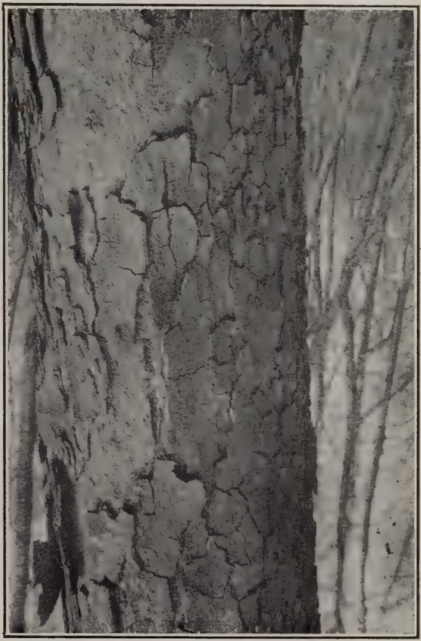

Fig. 71. BLACK BIRCH (Old.)
Trunk 27 inches in diameter.

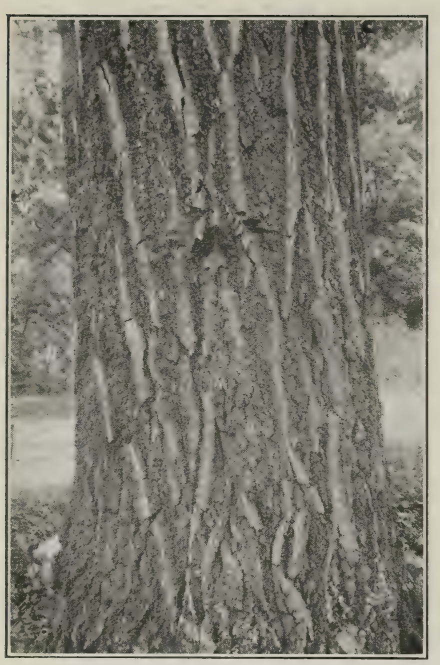

Fig. 72. RED OAK.
Trunk 46 inches in diameter.

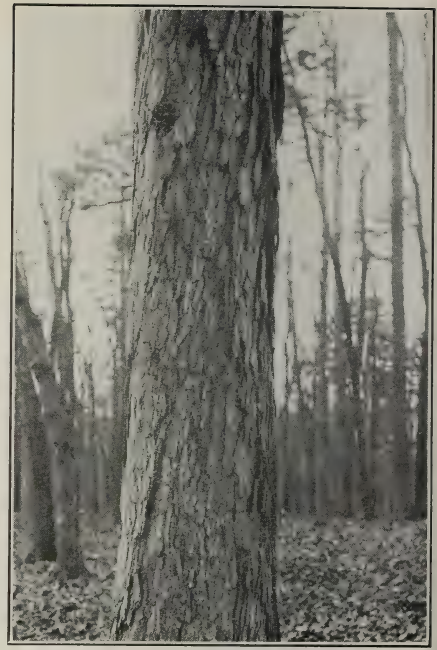

Fig. 73. WHITE OAK.
Trunk 30 inches in diameter.

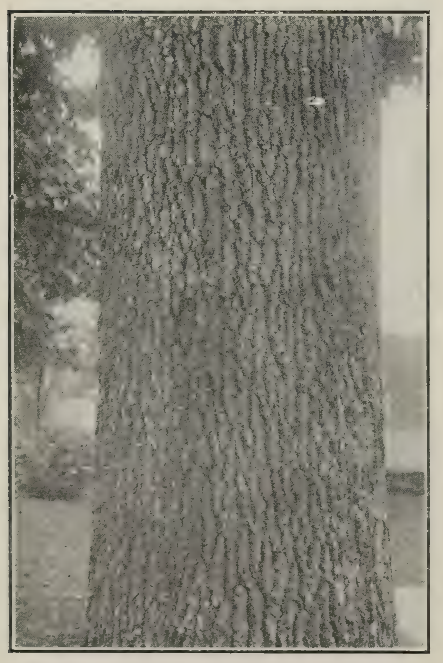

Fig. 74. BLACK OAK.
Trunk 42 inches in diameter.

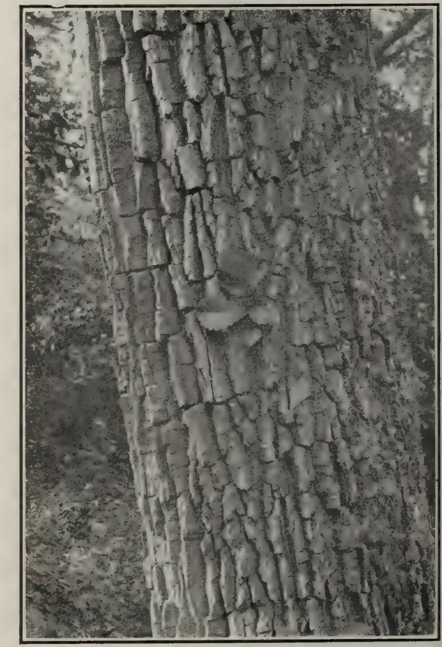

Fig. 75 ROCK OAK.
Trunk 34 inches in diameter.

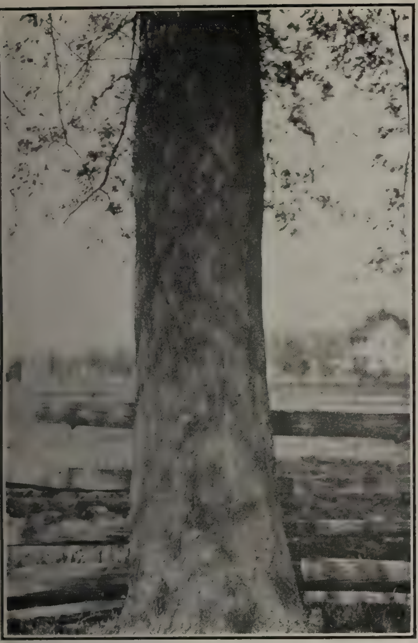

Fig. 76. PIN OAK.
Trunk 15 inches in diameter.

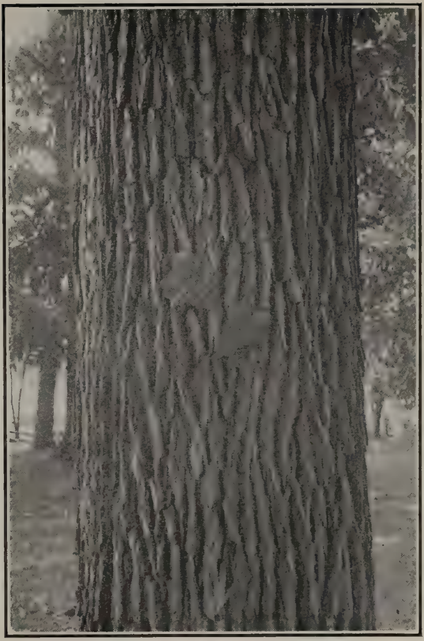

Fig. 77. SWAMP WHITE OAK.
Trunk 32 inches in diameter.

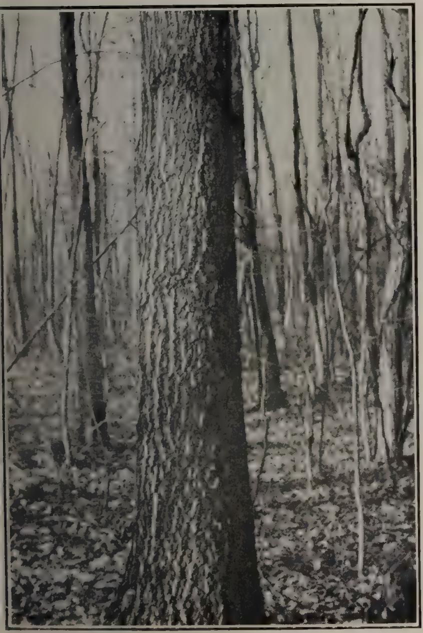

Fig. 78. SCARLET OAK
Trunk 14 inches in diameter.

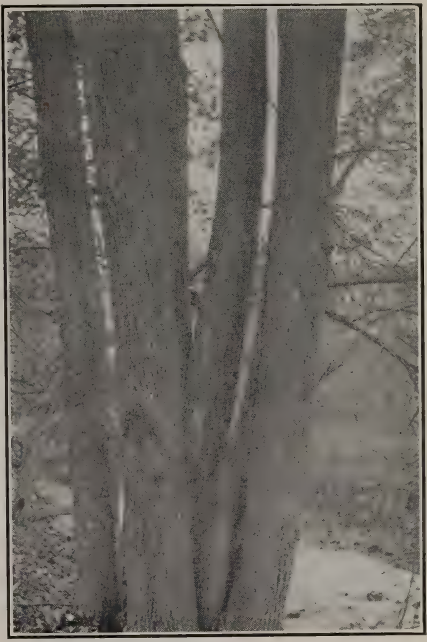

Fig. 79. BASSWOOD.
Trunks 8-14 inches in diameter

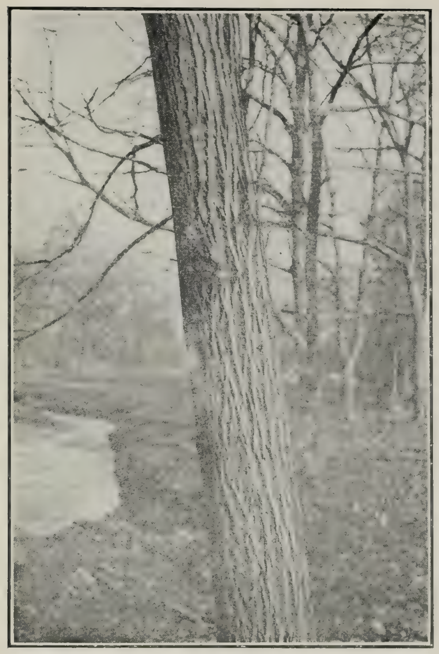

Fig. 80. BUTTERNUT.
Trunk 20 inches in diameter.

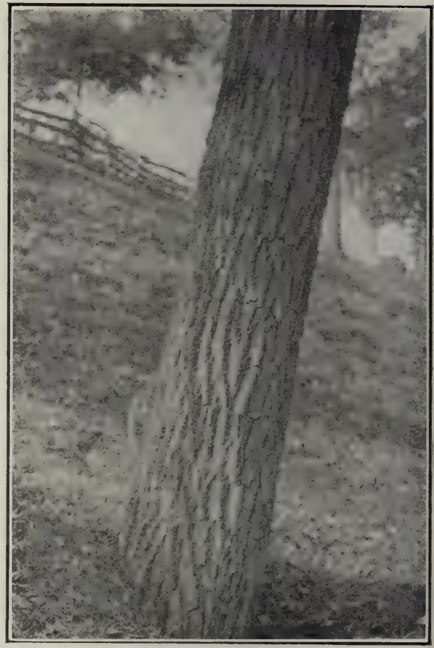

Fig. 81. BLACK WALNUT.
Trunk 24 inches in diameter.

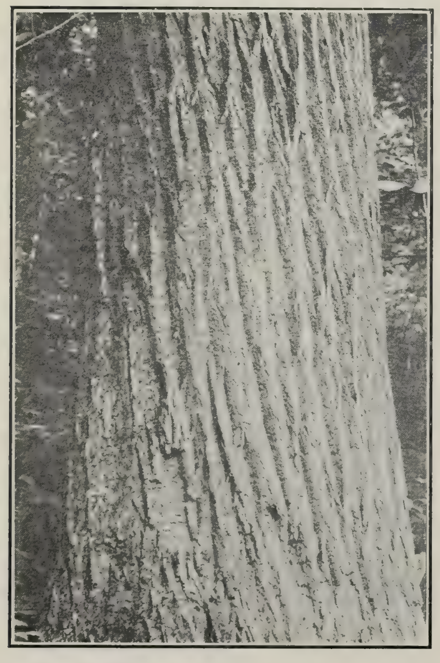

Fig. 82. CHESTNUT.
Trunk 62 inches in diameter.

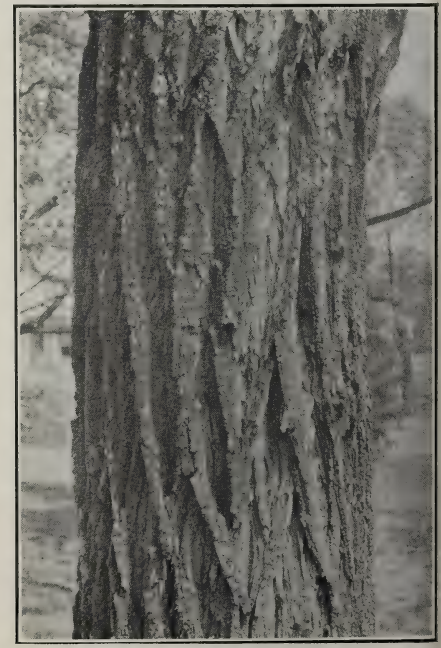

Fig. 83. BLACK LOCUST.
Trunk 18 inches in diameter

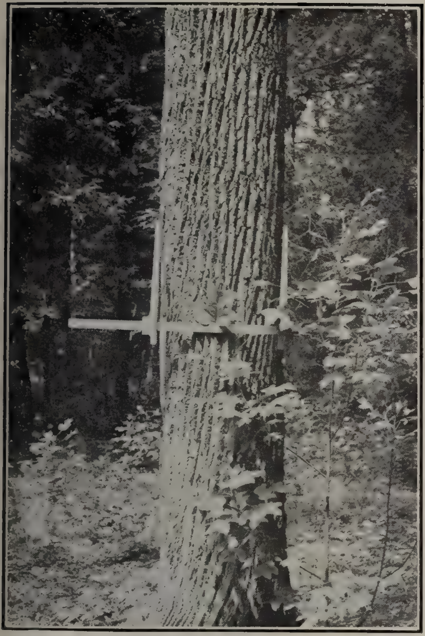

Fig. 84. TULIP TREE.
Trunk 21 inches in diameter.

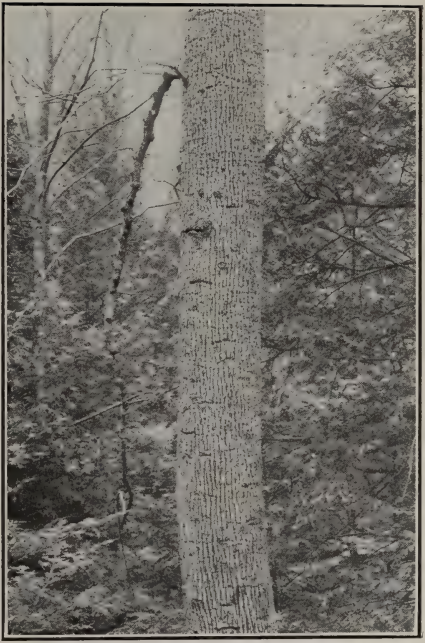

Fig. 85. CUCUMBER.
Trunk 26 inches in diameter.

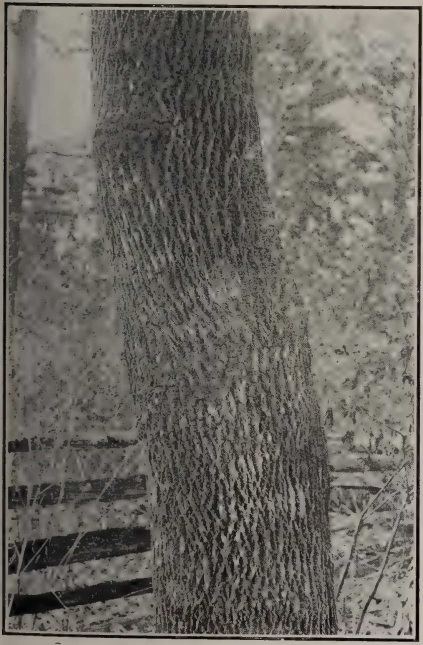

Fig. 86. WHITE ASH.
Trunk 30 inches in diameter

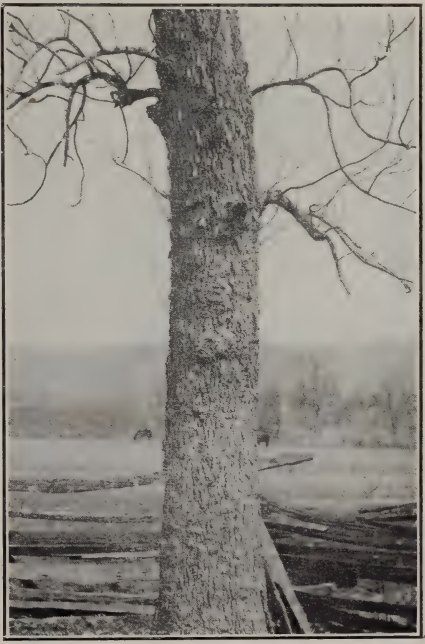

Fig. 87. BLACK ASH.
Trunk 22 inches in diameter.

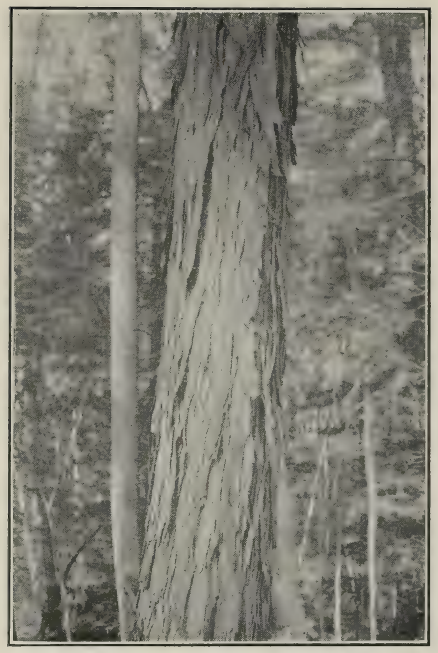

Fig. 88. SHAG-BARK HICKORY.
Trunk 26 inches in diameter.

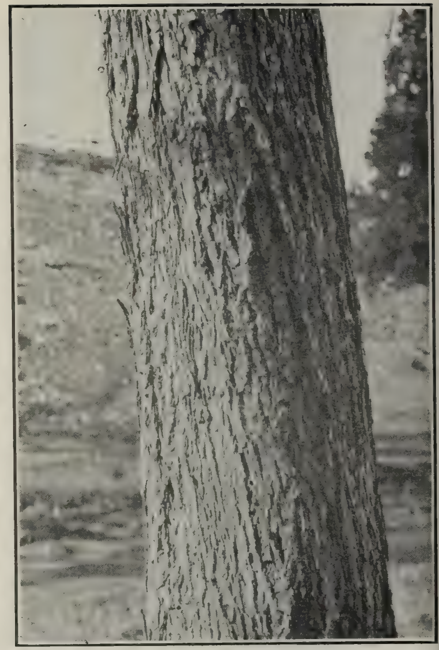

Fig. 89. PIGNUT HICKORY.
Trunk 22 inches in diameter.

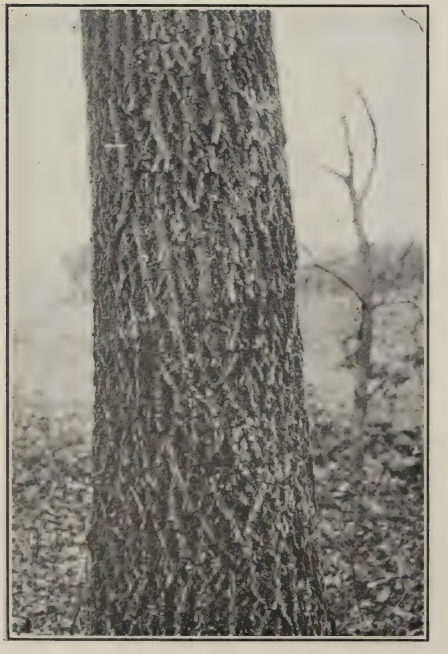

Fig. 90. MOCKER NUT HICKORY.
Trunk 18 inches in diameter.

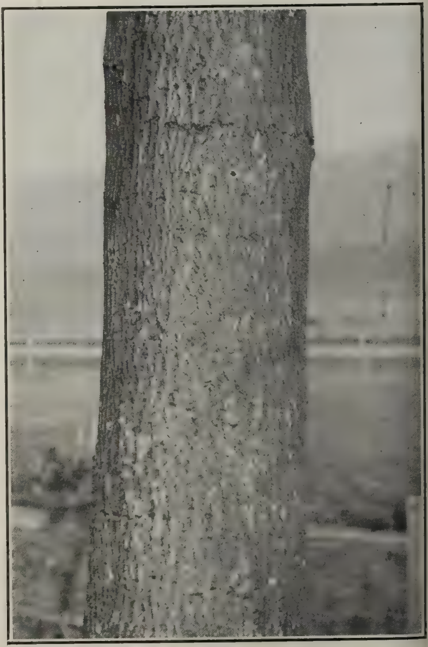

Fig. 91. BITTER NUT HICKORY.
Trunk 24 inches in diameter.

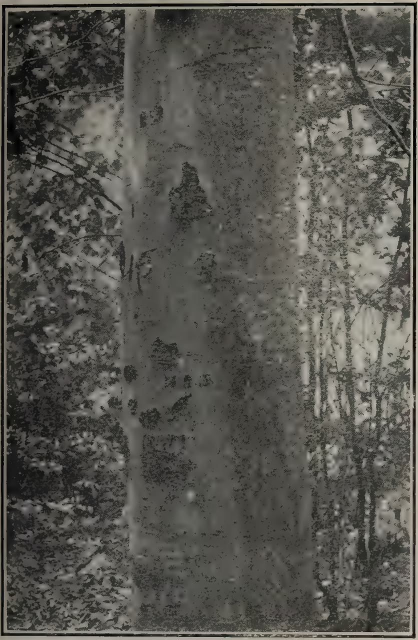

Fig. 92. BEECH.
Trunk 30 inches in diameter.

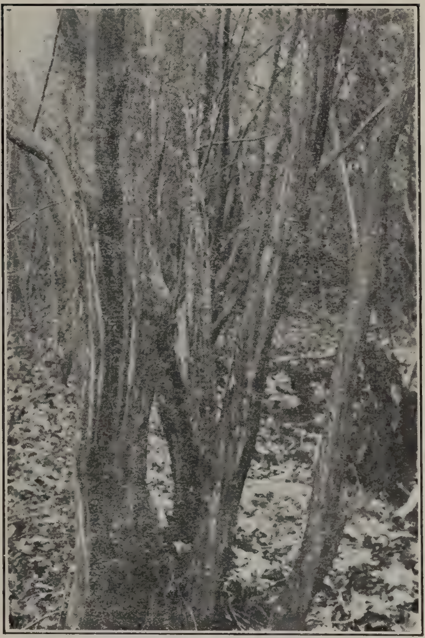

Fig. 93. AMERICAN HORNBEAM.
Trunk 6 inches in diameter.

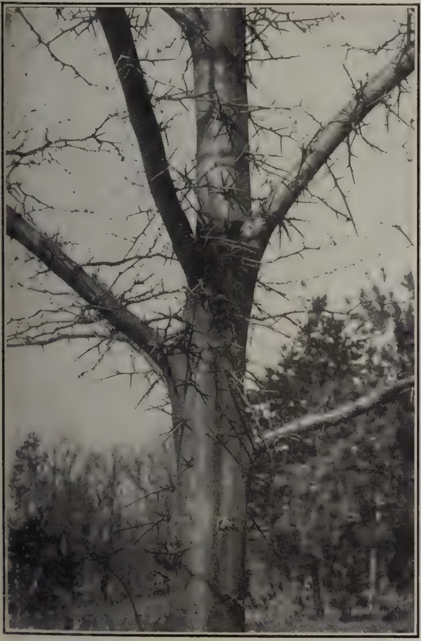

Fig. 94. HONEY LOCUST.
Trunk 10 inches in diameter

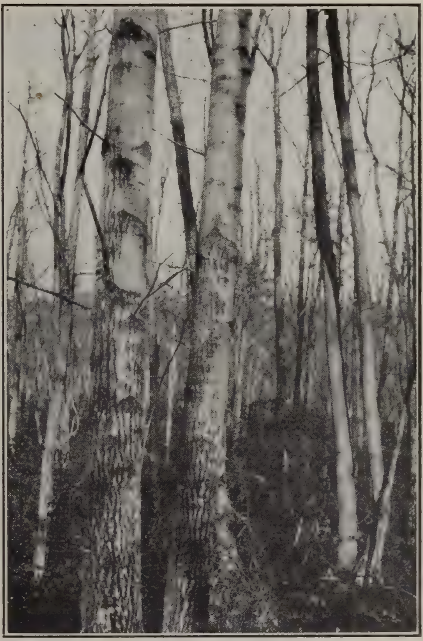

Fig. 95. LARGE-TOOTHED ASPENS.
Trunks 16 and 18 inches in diameter

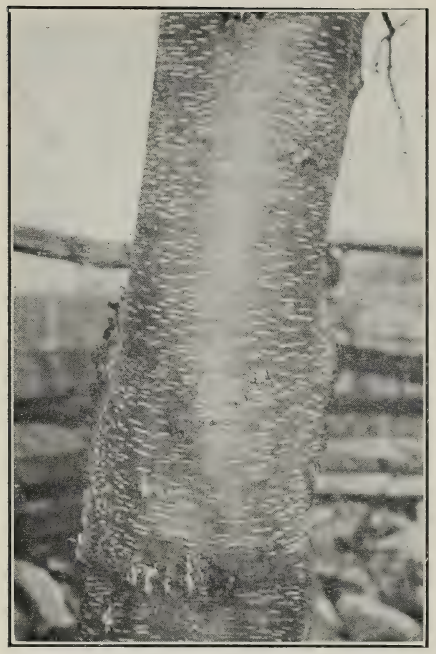

Fig. 96. WILD BLACK CHERRY.
Trunk 6 inches in diameter.

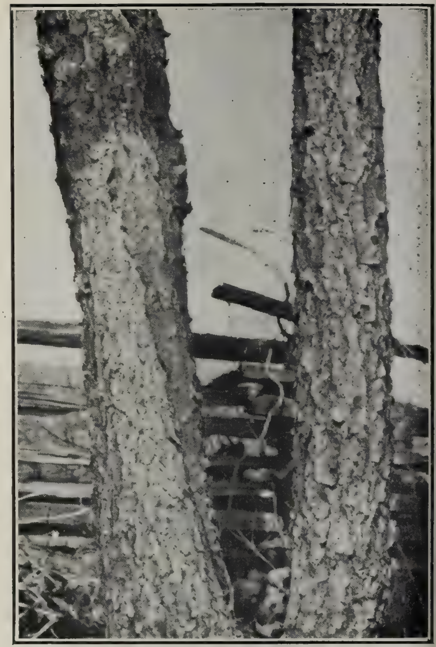

Fig. 97. WILD BLACK CHERRY.
Trunk 18 inches in diameter.

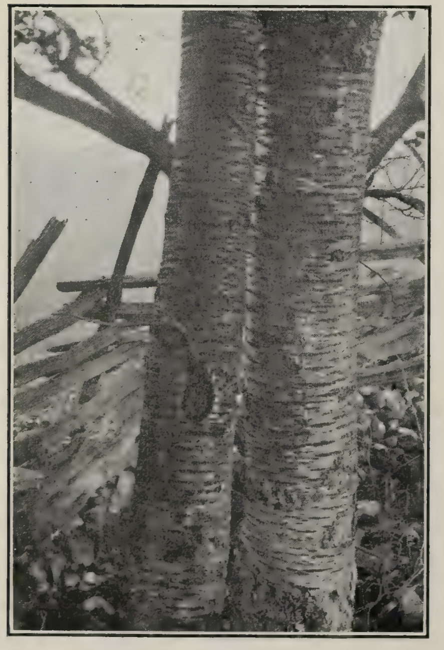

Fig. 98. DOMESTIC CHERRY.
Trunks 12 and 14 inches in diameter.

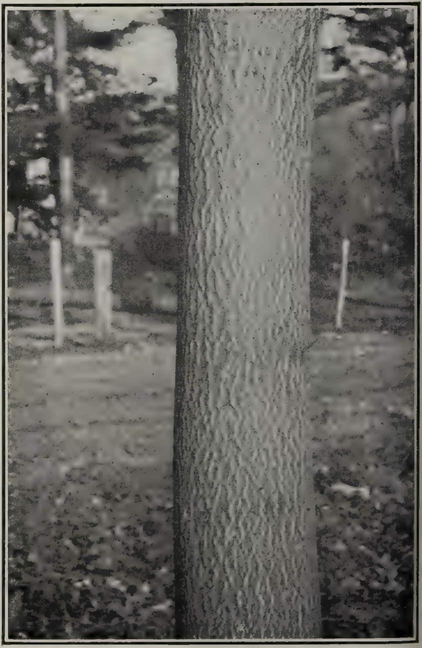

Fig. 99. TREE OF HEAVEN.
Trunk 12 inches in diameter.

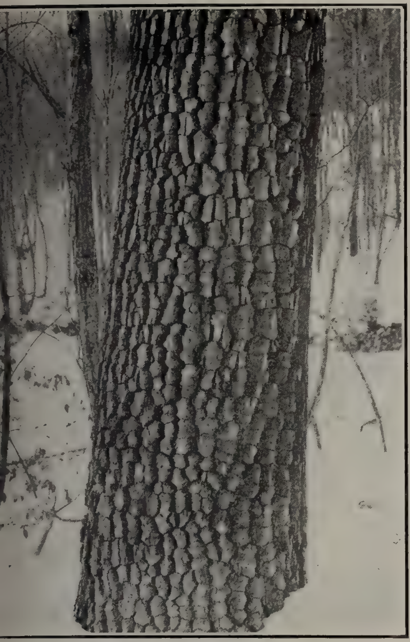

Fig. 100. BLACK GUM.
Trunk 22 inches in diameter.

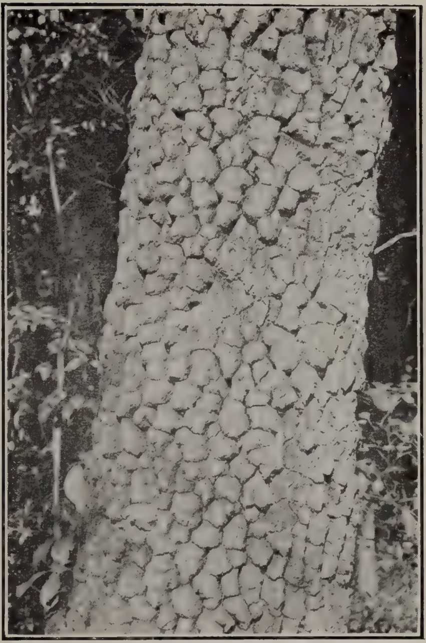

Fig. 101. PERSIMMON.
Trunk 12 inches in diameter.

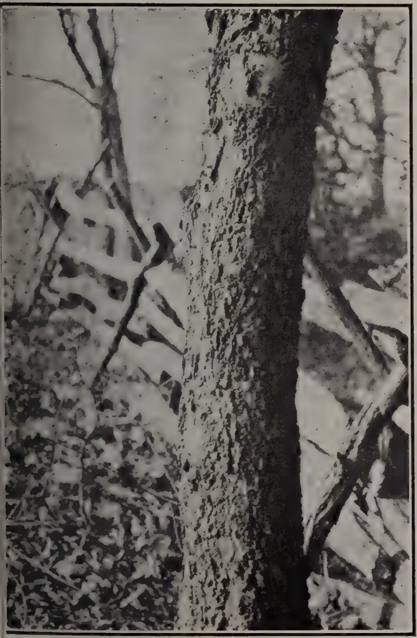

Fig. 102. HACKBERRY.
Trunk 8 inches in diameter.

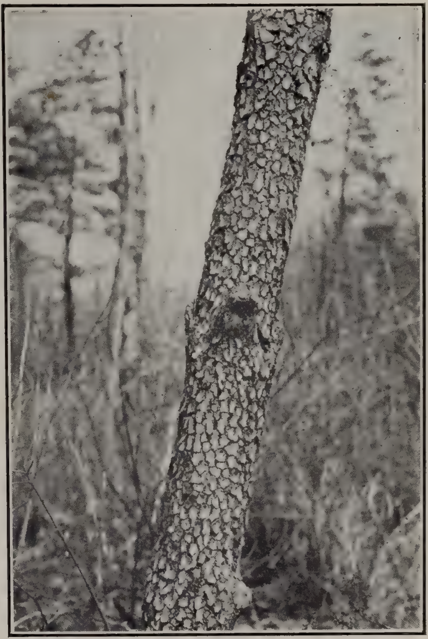

Fig. 103. FLOWERING DOGWOOD.
Trunk 6 inches in diameter.

as a protective covering while the latter is known as the inner or living bark and helps to convey the food which was manufactured in the leaves to various parts of the stem. Thickness of the bark is often determined by the rapidity with which it peels off. Its thickness, together with its larger number of dead, air-containing cells, makes it a very effective protective covering; but the chief protective feature of bark is the formation of corky layers. The chief function of the protective covering in plants is the prevention of excessive transpiration. The regular cork formations in the bark help very much in controlling transpiration. Cork is one of the most valuable elements of the bark. Its structure is complex and variable. Cork is impermeable to air and water, a poor conductor of heat, and a preventer of penetration by parasites. Local out-growths of cork like the wings of the Sweet Gum and Hackberry are probably of no value to the plants producing them. In some species the bark is not fully "ripened" at the end of the growing season, consequently the subjacent tissues do not have the necessary protection and frequently die back during the winter. The color of the bark varies in different species, in different situations, in different parts of the same species, and with the age of the trees. Young bark is usually green, but it soon loses this color due to the formation of cork and other substances. A few species like Sassafras retain their green color for a relatively long time due to deferred or late cork formation. Gray, brown, and black are the prevailing bark colors while red and white are also common. Color of the bark is very helpful in distinguishing many of our common trees. All the species of Birch native to Pennsylvania may be distinguished from each other by the color of their bark together with a few other bark characteristics. The bark on some of the older trunks becomes rough and then the characteristic color of the species may be present only on the branches and young stems. The outer bark may be uniform, mottled, or variegated in color. The interior and exterior parts of the bark may differ in color. Black Oak bark is yellow within and black without, while Hemlock is reddish within and brown to black without. The bark of the Buttonwood is peculiar since it is dark brown without and green, yellow, or white within. The inner bark often becomes very conspicuous due to the complete peeling off of the outer bark.

Young branches and stems are usually smooth since the bark expands sufficiently to accommodate the increased diameter growth of the interior. Later, in most species, the bark begins to crack, since the growth of the interior is too rapid for the expansion of the bark. In a few species like Beech, Blue Beech, and Balsam Fir the bark remains thin and smooth throughout life. Other species like Basswood and Pin Oak remain smooth for a long time but become furrowed later, while many other species become rough early in life. The manner in which the bark cracks open or peels off affords a ready means of identification for many of our trees. The exfoliation of the bark is rather constant for each species. In some species like the Yellow Birch and Paper Birch it peels off in thin film-like papery layers. In the Shag-bark Hickory it is shaggy; in many species like the Pines and Spruces it is scaly; while in others like the White Cedar it is shreddy. Many species have furrowed bark. The furrows run usually in a longitudinal direction but may run transversely. The furrows or fissures separate ridges. These vary with the species. The fissures may be short or long, close or distant, narrow or wide, longitudinal, transverse, or diagonal. The ridges may be pointed or broad, high or low, smooth or scaly. The bark may be broken up into small square or rectangular blocks as in the Black Gum. This form of bark is often spoken of as "alligator bark." See Figures 44-103 for bark of most of our important native trees.

The bark may be of considerable technical value. Hemlock and some species of Oak and Spruce have bark which is rich in tannin. The bark of these species is used extensively in the leather industry. The bark of a European species of Oak is highly prized on account of the large quantity of cork which it produces. The inner bark of some species yields dyeing material while that of others is used in the manufacture of fibre cloth. Formerly the bark of the Paper Birch was used in the construction of canoes.

3. TWIGS:

Twigs are the terminal parts of branches. The term twig usually refers to that portion of the terminal part of the branch which grew in the last season. Those portions of the branch which began their growth a few seasons ago are usually spoken of as older twigs or branchlets. The twigs have their origin in the vegetative buds which may be located on the terminal end of the twig of the previous season's growth or along its side. If they emerge from terminal buds they become leaders, and if from lateral buds they will develop into lateral branches. The lateral branches may be *alternate, opposite,* or *whorled* (Plate II). The method of branching is very helpful in distinguishing our common trees. The lateral branches of most of them alternate with each other, while a fair number are opposite and a few whorled. The terminal twig elongates rapidly while the lateral ones usually remain shorter and occasionally are compressed to a stub or spur.

When the vegetative buds burst open in spring young twigs, which are often covered with developing leaves, emerge from them. These twigs are, at first, usually delicate, greenish in color, and

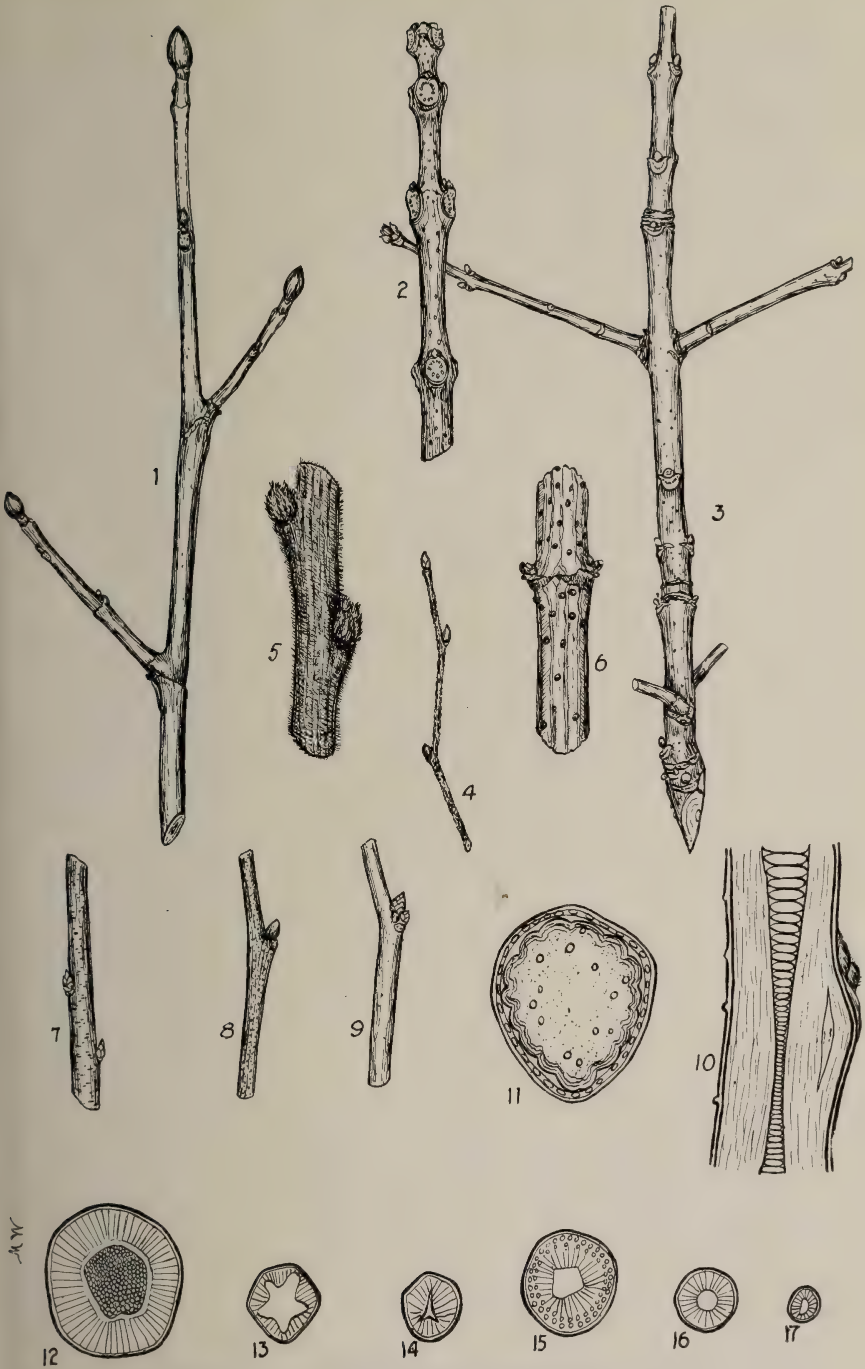

PLATE II. TYPES OF TWIGS AND PITH.

1. Tulip Tree (alternate branching).
2. Catalpa (whorled branching).
3. White Ash (opposite branching).
4. Gray Birch (slender and warty).
5. Staghorn Sumach (hairy).
6. Elderberry (lenticels prominent).
7. Black Cherry (lenticels transversely elongated).
8. Chestnut (lenticels small and numerous).
9. Black Gum (lenticels few and inconspicuous).
10. Black Walnut (chambered pith).
11. Sumach (large pith).
12. Sassafras (medium-sized pith).
13. Oak (star-shaped pith).
14. Black Alder (triangular pith).
15. Common Locust (angular pith).
16. Elm (circular pith).
17. Birch (semicircular or irregular pith).

Drawings are about one-half natural size.

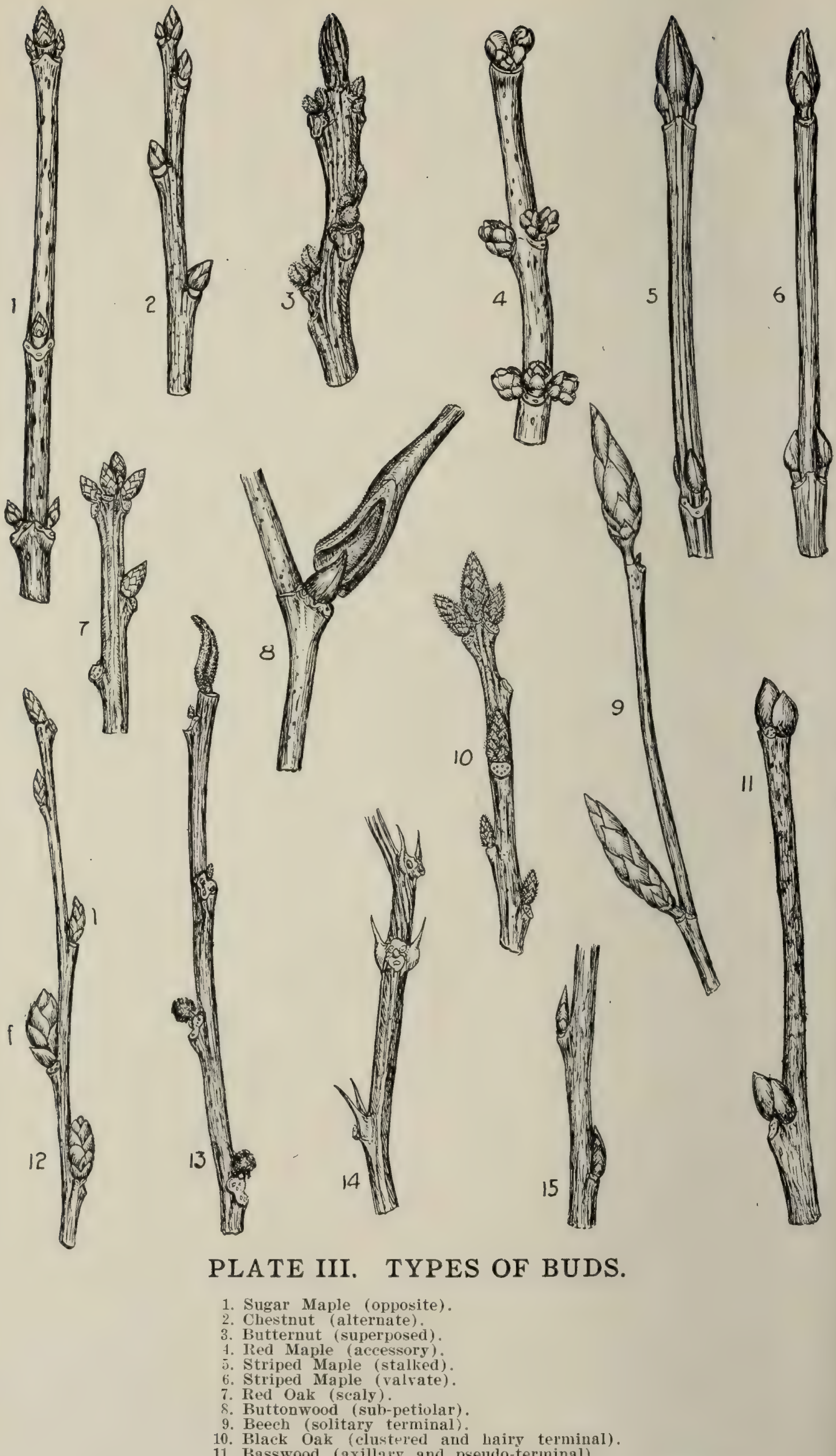

PLATE III. TYPES OF BUDS.

1. Sugar Maple (opposite).
2. Chestnut (alternate).
3. Butternut (superposed).
4. Red Maple (accessory).
5. Striped Maple (stalked).
6. Striped Maple (valvate).
7. Red Oak (scaly).
8. Buttonwood (sub-petiolar).
9. Beech (solitary terminal).
10. Black Oak (clustered and hairy terminal).
11. Basswood (axillary and pseudo-terminal).
12. American Elm, showing (1) leaf buds and (f) flower buds.
13. Papaw (naked flower- and leaf-buds).
14. Common Locust (imbedded).
15. Trembling Aspen (sharp-pointed).

Drawings are about one-half natural size.

often hairy. As they develop during the season they become firmer and often lose their green color and their hairs. The direction of the new growth is variable. In many species it takes at first a drooping direction and later, as its elements become firmer, it assumes a horizontal or ascending position. The new growth of the Pines is conspicuous in that it grows in an erect direction at first and later becomes horizontal or drooping.

The taste, smell, and color of the twigs are helpful in distinguishing some of our common species. The twigs of some species as the Black Birch, Spice Bush, Sassafras, and Wild Cherry have a characteristic taste and smell. The color of the twigs may be green as in the Sassafras, red as in the Basswood and Red Maple, or brown as in the Sugar Maple. Many other different colors and combinations of color aid materially in distinguishing our trees.

Some twigs are rough while others are rather smooth. They may be roughened by hairs, lenticels, raised leaf-scars, bud-scale scars, warty or resinous exudations, corky projections, or decurrent projections of the bark. If we examine a young twig just after it has emerged from the bud we will find that it is usually green in color. At the end of the first season's growth a thick bark has usually developed which is no longer green on the surface, but, by cutting a cross section of a twig, one will often find that the inner bark is still green. This green tissue develops chlorophyll and manufactures food just as does the green tissue of the leaves. As the bark increases in thickness the chlorophyll decreases, eventually disappearing entirely from the stem. In order that this green tissue in the bark may function it is necessary that gases be exchanged through the bark. Special structural modifications on the bark known as *lenticels* (Figs. 96 and 98) make possible this exchange of gases just as the stomata on the leaf-surfaces allow and even regulate the exchange of the gases of the leaf.

The lenticels are very numerous and conspicuous on some species, while on others they are rare and inconspicuous. They are raised on some species like the Elder, while on others they are even with the bark. Their color varies. They may be white, gray, pinkish, yellow, brown, or black. In outline they are usually circular or slightly elongated. In the Cherries and Birches they are confluent, a characteristic which results in the horizontally elongated lines of lenticels (Figs. 96 and 98) so common on their trunks.

The duration of the lenticels varies with the species and its environment. As a rule the more rapidly bark is formed the shorter is the duration of the lenticels. On some species it is difficult to find lenticels on any but the last season's growth while on others they may persist for some years. The exfoliation of the bark causes their disappearance. On a few species like the Birches, Cherries, and Honey Locust they persist for many years.

The distribution of lenticels has not yet been systematized. They are distributed rather uniformly over the newer growth but are irregularly spaced. In some species they seem to be somewhat clustered just below the nodes and in others like Honey Locust they are more numerous on the lower side of horizontal branches.

The pith usually occupies the central portion of twigs, branchlets, and roots. It is composed of thin-walled cells which are loosely aggregated. It seldom increases in size after the first year. The pith of a tree 100 years old is usually not wider than that in a year old twig of the same species. It becomes functionless early in the life of a tree.

The pith of conifers is rather uniform in outline, structure, and color, but in the broad-leaved species it is very variable. In most species it is small in proportion to the size of the twigs, but in a few species like Sumach, Elder, Sassafras, Ailanthus, and Kentucky Coffee-tree it is relatively large. The outline in cross section may be 5-angled or star-shaped as in the Oaks, Chestnut, and Aspens, 3-angled as in Alder and some Birches, angular as in Common Locust, circular as in Elm, and ovoid as in Basswood. As a rule the pith is continuous, but in a few species like Black Walnut, Butternut, and Hackberry it is chambered. A few species like Catalpa have continuous pith except at the nodes where it is sometimes chambered. A less distinct separation of the pith is found in Black Gum, Papaw, Tulip Tree, and the Magnolias where plates of stone cells occur. The color of the pith may be white as in the Sugar Maple, pinkish as in Red Maple, brown as in Striped Maple, Mountain Maple, Sumachs, and Walnuts, red as in Kentucky Coffee-tree, or greenish as in Shad Bush.

4. Buds:

In temperate and colder climates the growing season extends over a part of the year only. During the warmer part of the year vegetation is active, but as soon as the weather becomes cooler, many annual plants die while others make special preparation for the winter. One of the preparations is the formation of buds. They are formed in most trees and shrubs of cold and arid climates. If we examine a twig from one of our common trees in the month of July we can usually find buds starting to develop in the axils of the leaves. They continue to develop until they have reached a certain size, and then remain in an inactive condition for a few months in winter, only to become active again when favorable growth conditions return in spring. A year usually includes a period of rest alternating with a period of activity. Buds may be divided into two classes, *active* and *resting*. Active buds are growing or developing buds, such as one finds in late summer prior to the period of rest and early in spring when the resting buds have been awakened from their winter's slumbers. The resting buds are commonly known as *winter buds* (Plate III).

Buds are protected growing points. The degree of protection given to the growing points varies with the species. A few of our trees and shrubs have buds which are nearly or quite destitute of a scaly covering. These are know as *naked buds.* The protection usually consists of scales which may be supplemented by hairy outgrowths, resin, gums, or air spaces. These are known as *scaly buds.* The buds may be covered by numerous overlapping scales, known as imbricated bud-scales, or they may be covered by simply one or two visible scales which do not overlap. The buds of the Willows and Buttonwood are covered by a single visible bud-scale, while the buds of such species as the Striped Maple and the Black Alder have only two visible bud-scales whose margins simply meet and do not overlap. The latter are known as *valvate buds.* The buds may also receive protection from the enlarged bases of the stalk of leaves which often persist far into winter. The buds covered by the enlarged base of the leaf-stalk are known as *subpetiolar buds.* The buds of some of our common trees are very inconspicuous. It is often difficult to locate them when sunken so deeply into the bark that only the tip is visible. The size of the buds is not indicative of the size of the flowers or leaves which they will produce the following season. Many of the trees which bear small and inconspicuous buds produce large and conspicuous flowers and leaves. The principal functions of the protective covering of buds are the prevention of the loss of water from the tender parts within and the protection of their delicate interior from mechanical injury. Some add that the protection also minimizes the damaging effect of sudden temperature changes.

The position of buds is of considerable value in distinguishing many of our trees and shrubs. They may occur at the end of the twigs or along their sides. The former are known as *terminal buds* and the latter as *lateral buds.* The terminal buds may be solitary as on the Beech or clustered as on the Oaks. On most of our trees and shrubs the lateral buds appear just above the origins of leaf-stalks and are known as *axillary buds.* They may occur in pairs, one on one side of the twig and the other exactly opposite, or singly forming a spiral around the twig. The former are known as *opposite buds* and the latter as *alternate buds.* The axillary buds may occur solitary or in groups, either one above the other, or side by side. If they occur one above the other they are known as *superposed buds* and if they occur side by side they are known as *accessory* *buds.* Sometimes axillary buds remain inactive for a long period of time without losing their vitality. Such are known as *dormant buds.* During their dormant period they remain on the surface of the trunk by the elongation of their connection with their point of origin. A superabundance of food, excessive light, or the death of a great number of terminally located buds, may stimulate them into activity again. A great number of these buds are often found along the stem of such species as Chestnut and Rock Oak. They develop into short branches which are known as "water sprouts." Some buds are produced at rather unusual points, and in irregular positions along the stem, and are called *adventitious buds.* They also form "water sprouts."

One finds a wide variation in the size and form of the buds which our common trees produce. Some are long and slender; others are short and stout. Some of them are round in cross-section; others are angular. Some are sharp-pointed; others are blunt-pointed. The buds also vary in the manner of their insertion on the twigs. Some are inserted directly on the twig; others are separated from the twig by a stalk, and still others may be almost entirely covered by the twig. The former are called *sessile buds,* the next *stalked buds,* and the latter *imbedded buds.*

The kind of buds which a tree produces is of considerable importance, especially where fruit trees are considered. Three principal kinds of buds may be distinguished:—*leaf buds,* also known as *vegetative buds,* the contents of which will develop into stem and leaves; *mixed buds,* the contents of which consist of leaves and flowers in their formative stage; and *flower buds,* also known as *propagative buds,* which contain the elements of flowers only. How can one find out what kind of buds are at hand? The buds may be cut open by means of a sharp knife and their contents studied with the aid of a magnifying glass. One may also take a twig and place it in a jar of water in a warm room and in about a week the buds will have expanded far enough to reveal the nature of their contents. The twig with its buds may also be left on the trees and its development observed in spring when nature opens them. With all this variation in the position, insertion, form, structure, and kind of buds we still find here, as in all nature, law and order.

5. Leaves:

The shoot of a seed plant consists of stem and leaves. The leaves of our common trees are excellent distinguishing characters by which the species may be recognized. They are variable in form. This variation, as well as the work they do, is little appreciated by the crowds which annually seek their shade and shelter. This chapter

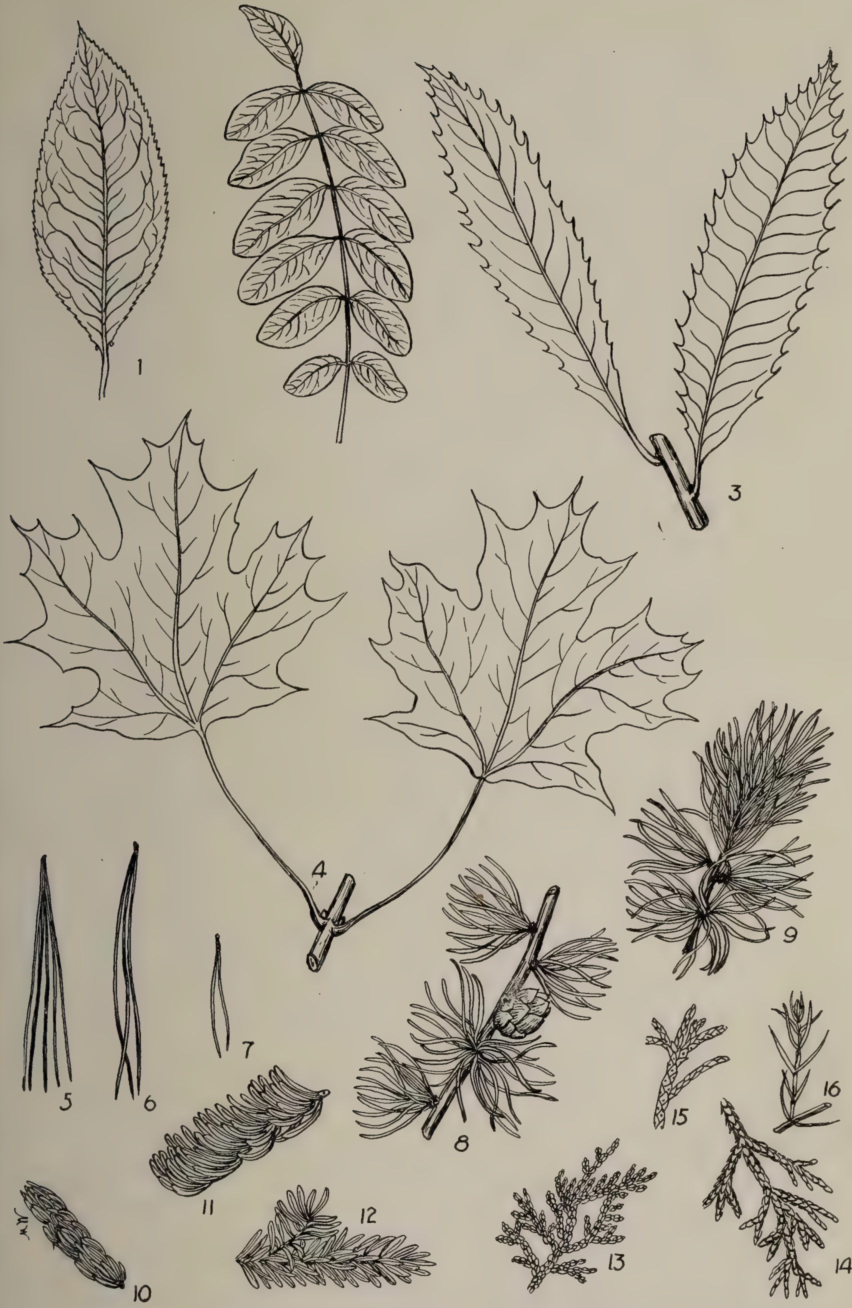

PLATE IV. TYPES OF LEAVES.

1. Black Cherry (simple).
2. Common Locust (compound).
3. Chestnut (alternate arrangement).
4. Sugar Maple (opposite arrangement).
5. White Pine (5-clustered).
6. Pitch Pine (3-clustered).
7. Jersey or Scrub Pine (2-clustered).
8. Larch (many clustered).
9. Larch (many clustered at base; solitary on leading shoots).
10. Red Spruce (4-sided).
11. Balsam Fir (flat and sessile).
12. Hemlock (flat and stalked).
13. Red Cedar (scale-like needles).
14. Arbor Vitae (scale-like needles).
15. Arbor Vitae (section enlarged showing glands on leaves).
16. Red Cedar (awl-shaped needles).

Drawings are about one-half natural size.

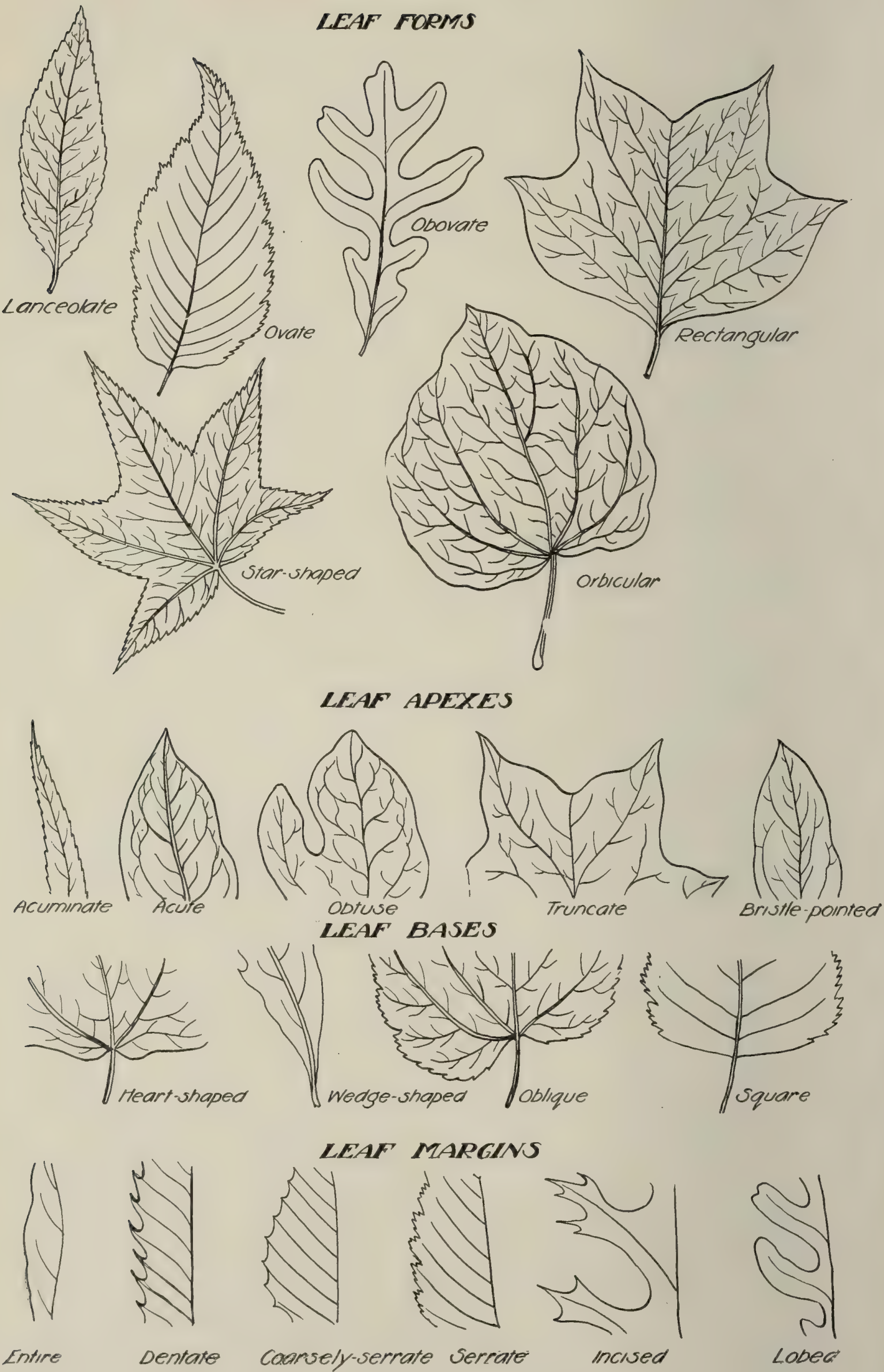

PLATE V. TYPES OF LEAVES.

aims to give a general description of leaves and a brief outline of their work.

A typical foliage leaf consists of three parts: (1), the *blade* or flattened portion (lamina); (2), the *leaf-stalk* (petiole); and (3), the *leaf-appendages* (stipules).

Two kinds of leaves are usually recognized:—*simple* and *compound* (Plate IV). Simple leaves have blades which are more or less united into one piece, while in compound leaves each leaf is composed of a number of smaller leaflets. Compound leaves may have all the leaflets originate from one point as in the Buckeyes (Plates CXII, CXIII), or scattered along the main petiole as in the Common Locust (Plate XCVII). Each primary division of a compound leaf may again be compounded as in the Kentucky Coffee-tree (Plate XCIV). Such a leaf is known as a *doubly compound leaf.*

The arrangement of the leaves on the twigs and branches of our common trees may be *alternate, opposite,* or *whorled* (Plate IV). When the arrangement is alternate, the individual leaves are located singly at a node; when opposite, two leaves occur opposite each other at a node; and when whorled, more than two leaves occur at a node and are distributed regularly around the twig. In a few species as the Birches, the leaves of the lateral spurs appear to be opposite, but upon closer examination they are found to be alternate.

The leaves of the trees native to this State may be classified as follows: (1), Trees with needle-shaped leaves, known as conifers or evergreens, and (2), trees with broad leaves known as hardwoods or deciduous trees. The needle-shaped trees show a wide variation in the form and distribution of their needles. They may occur singly, in fascicles of 2, 3, or 5, or in clusters on lateral spurs; they may also be stalked or sessile, scale-like or awl-shaped, and flat, semi-circular, triangular, or four-sided in cross-section. The broad-leaved trees have an even wider variation in form. This may be in part due to the greater number of representatives belonging to this order. A few of the commonest leaf forms are shown on Plate V. Other intermediate forms are commonly found among our trees. The size of the leaves varies as much as their form. They may be small, scale-like, or awl-shaped as in the Arbor Vitae and Common Juniper respectively, or large and tropical-like as in the Magnolias and Papaw.

The point, or apex, of leaves varies with the species and the general leaf-form. The commonest kinds of points recognized are shown on Plate V.

The bases of leaves are also often characteristic and of considerable value in distinguishing species, since different species may have the same general form but different bases. The commonest kinds of bases recognized are shown on Plate V. Intermediate forms may readily be found, since leaves taken from the same tree or branch often show a wide variation.

The margins of leaves are often more variable than their apexes and bases. The kinds most commonly recognized are shown on Plate V. The figures represent the margins of simple leaves, but the margins of the leaflets of compound leaves follow the same terminology.

Most of the leaves of our common forest trees contain a rather complicated system of fibro-vascular bundles. These fibro-vascular bundles, known as veins, form the framework of the leaves. Surrounding and between these veins is found a green pulpy mass, the spongy parenchyma. The whole body of the leaf is covered by a protective covering known as the epidermis, the thickness of which varies with the species of tree and the climate.

One can find variations in the petiole and stipules of leaves as well as in the blade. The petiole may be absent, short, or long. When the petiole is absent the leaf-blade is *sessile.* It may also be enlarged at the base, circular, heart-shaped, flat, or triangular in outline. The enlarged base may be hollow or clasping. The stipules are usually not very conspicuous. In many species they persist for a short time only and then fall off. The main function of the stipules is protection, but a special modification of the stipules is seen in the Common Locust (Plate XCVII), where the thorns are modified stipules and function as mechanical protectors.

Leaves are the most industrious organs of a plant. They work day and night from early spring until autumn. The four chief functions of leaves are: (1) Photosynthesis; (2) Respiration; (3) Transpiration, and (4) Assimilation. Photosynthesis is the process by which the leaf manufactures starch or sugar from carbon dioxide and water with the aid of the energy of light. That green plants require light for their growth and development is shown by the manner in which the axis and their leaves adjust themselves so as to receive the greatest amount of light. By respiration in plants is meant the process by which oxygen is consumed and carbon dioxide and water are given off. It is primarily a process of oxidation and resembles in general the process of respiration as found in man and higher animals. In order to facilitate this exchange of gases the plants are supplied with openings on the leaf surfaces, especially on the lower surface, and on the bark. The openings on the leaf surfaces are known as stomata and those on the bark as lenticels. Each slit-like opening on the leaf is surrounded by two guard cells which are somewhat complicated in structure and very sensitive to changes in temperature and water supply. They function primarily as breathing pores and as outlets for the water vapor given off during the process of transpiration. Their number varies, but it has been

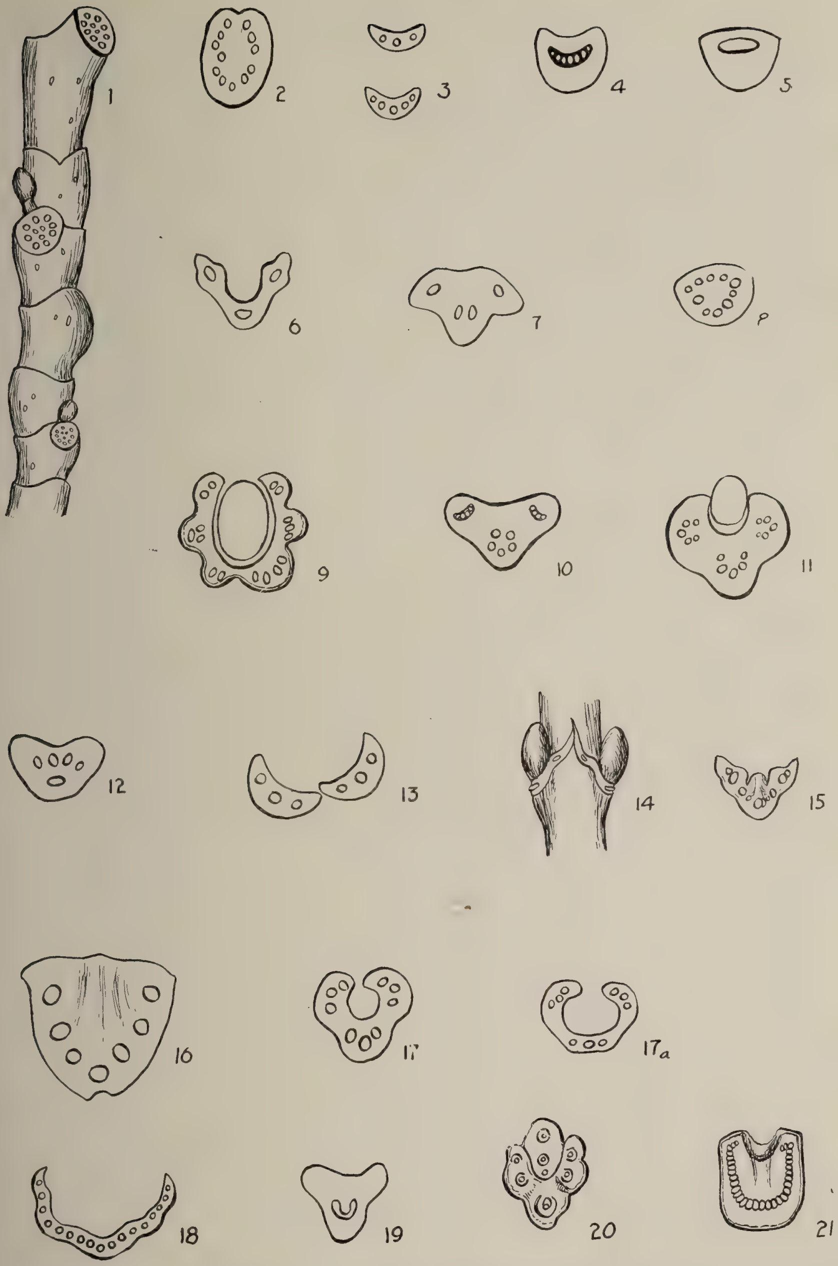

PLATE VI. TYPES OF LEAF-SCARS AND BUNDLE-SCARS.

1. Tulip Tree.
2. Catalpa.
3. American Hornbeam.
4. Sassafras.
5. Persimmon.
6. Maple.
7. Poplar.
8. Red Mulberry.
9. Buttonwood.
10. Chestnut.
11. Walnut.
12. Basswood.
13. Birch.
14. Box Elder.
15. Papaw.
16. Horse Chestnut.
17. Dwarf Sumach.
17a. Staghorn Sumach.
18. Hercules' Club.
19. Sour-wood.
20. Kentucky Coffee Tree.
21. Ash.

All drawings are slightly enlarged.

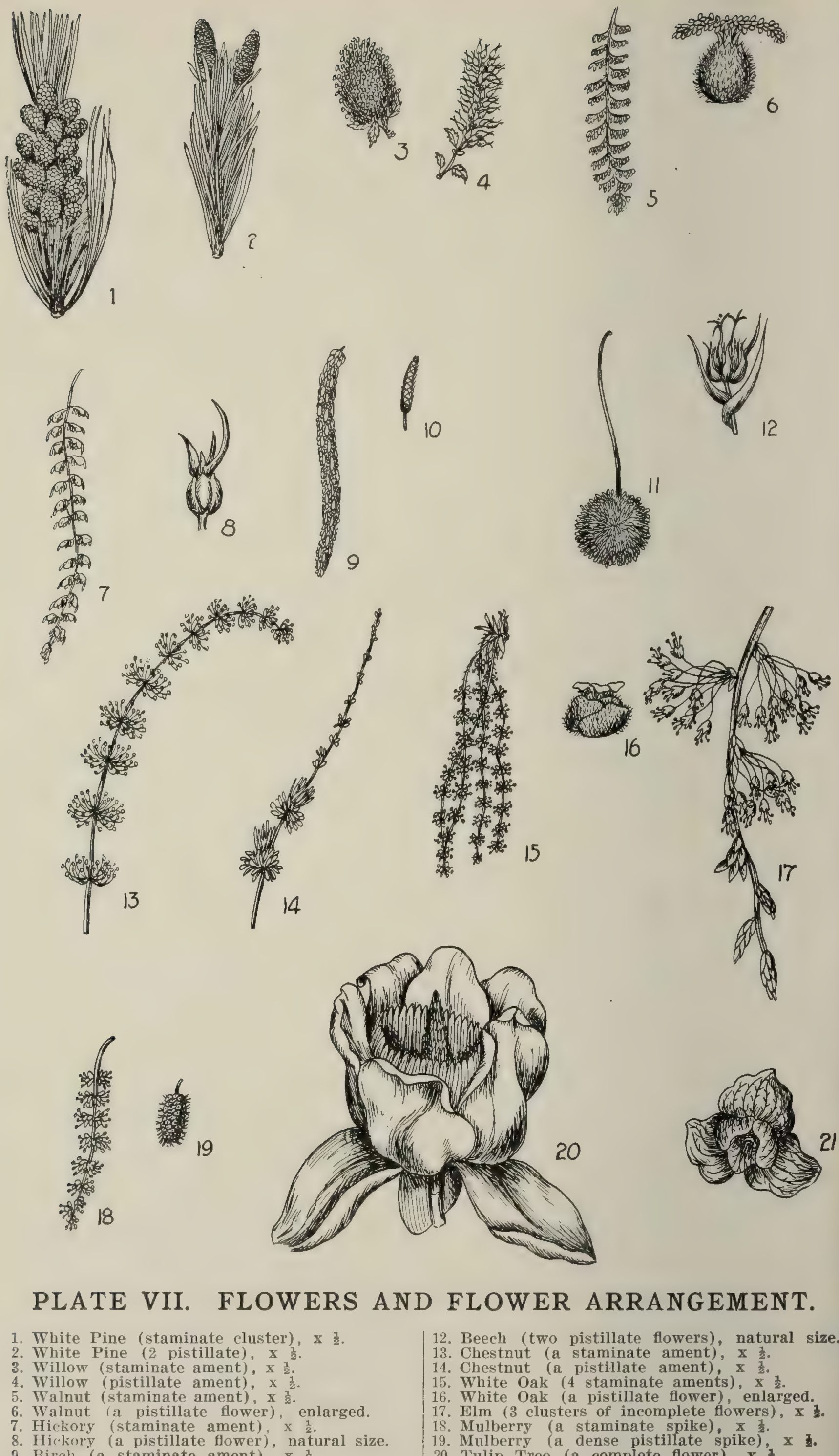

PLATE VII. FLOWERS AND FLOWER ARRANGEMENT.

1. White Pine (staminate cluster), x ½.
2. White Pine (2 pistillate), x ½.
3. Willow (staminate ament), x ½.
4. Willow (pistillate ament), x ½.
5. Walnut (staminate ament), x ½.
6. Walnut (a pistillate flower), enlarged.
7. Hickory (staminate ament), x ½.
8. Hickory (a pistillate flower), natural size.
9. Birch (a staminate ament), x ½.
10. Birch (a pistillate ament), x ½.
11. Beech (a staminate head), x ½.
12. Beech (two pistillate flowers), natural size.
13. Chestnut (a staminate ament), x ½.
14. Chestnut (a pistillate ament), x ½.
15. White Oak (4 staminate aments), x ½.
16. White Oak (a pistillate flower), enlarged.
17. Elm (3 clusters of incomplete flowers), x ½.
18. Mulberry (a staminate spike), x ½.
19. Mulberry (a dense pistillate spike), x ½.
20. Tulip Tree (a complete flower), x ½.
21. Papaw (a complete flower), x ½.

estimated that the lower leaf surface of Black Walnut contains about 300,000 per square inch. The leaf is not only peculiarly modified for the reception of light and the absorption of gases, but also for the loss of water. This process of losing water in the form of vapor through the stomata is known as transpiration. The large amount of water given off by trees is usually not appreciated. The Austrian Forest Experiment Station has published data which show that an open-grown birch tree with 200,000 leaves transpired on hot summer days from 700 to 900 pounds. Assimilation, the fourth of the functions named above, comprises a series of changes which are necessary to transform the raw or newly manufactured food material into actual plant tissue.

6. Leaf-scars and Bundle-scars:

Most of our trees and shrubs, except the cone-bearers, shed practically all their leaves in autumn. Those which shed their leaves in this manner are known as *deciduous* trees, while those which retain them for two or more seasons are known as *evergreen* trees. When the leaf falls a scar is left at the point of its insertion. The leaf-scars vary in size, form, position, occurrence, and the number of vascular bundles which they contain (Plate VI). They may occur singly, in pairs, or in whorls, just as the leaves which precede them. They appear at points on the twigs known as *nodes*. The portion of the twig between the nodes is called the *internode*. They may be large, medium, or small in size depending upon the species. If they occur in pairs on opposite sides of the twig they may be so large that they completely encircle the stem, or only a portion of it. Their form may be round, oval, elliptical, heart-shaped, shield-shaped, crescent-shaped, lobed, or triangular. They may be raised, depressed, or even with the surface of the twig. Their surface may be flat, concave, smooth, or wavy.

The leaf-scars contain bundle-scars. The bundle-scars mark the position of the vascular bundles which formed a connection between the leaves and the twigs. They carry liquid material to and from the leaves. Two distinct portions may be distinguished in these vascular bundles; the woody portion which serves to carry water into the leaf, and the sieve-tube portion which serves to carry plant food from the leaves where it was manufactured, down into the twigs, branches, and stem. These bundle-scars vary in size, form, and number in a leaf-scar, and the manner in which they are distributed. Some of our common forest trees have only one bundle-scar in a leaf-car, while many have three, and others four, five, to many. The umber is constant in some species and variable in others. The inividual bundle-scars usually are circular in outline but may be near, crescent-shaped, or irregular. Where more than one is found in a leaf-scar they vary in their arrangement. They may form a closed ellipse, a lunate line, a double line, a V-shaped or a U-shaped line, or they may be irregularly scattered over the leaf-scar, or grouped in clusters. A number of bundle-scars may sometimes be grouped so close together so as to form a compound bundle-scar or a line of confluent bundle-scars. The leaf-scars together with their bundle-scars are excellent characters with which to distinguish many of our common forest trees during winter when most of the distinguishing characteristics which one can use in summer are absent. By carefully studying these characteristics, together with others, it is as easy to distinguish the forest trees in winter as in summer when the foliage is present.

7. Flowers:

Sometime in their life history plants usually give rise to others of their kind. The method which they use to accomplish this varies with the species or the group. Most of our trees develop flowers whose chief function is pollination, the initial step in the production of seeds. The existence of flowers is consequently for the good of the plant and not for the good of man, even though their beautiful forms and colors do please his fancy and make his life happier.

The flowers of our common trees vary considerably in form, structure, and color (Plates VII, VIII). Most of them are very modest in appearance while a few of them are conspicuous on account of their large size and brilliant color. In speaking of the flowers of our trees collectively, one often hears the phrase "The uncommon flowers of our common trees." The truth of this phrase becomes clear when we think of the small and inconspicuous pistillate flowers which such trees as the Oaks, Birches, American Hop Hornbeam, Walnuts, Hickories, and others produce. A few species like the Magnolias, Cherries, Dogwoods, Tulip Tree, and Basswood produce rather conspicuous flowers.

The parts of a flower are of two general kinds—the *essential organs* which are concerned in the production of seeds and the *floral envelopes* which act as protecting organs. The essential organs consist of two series,—the outer which is composed of *stamens* and bears the pollen, and the inner which is composed of *pistils* and bears the seeds. The floral envelopes also usually consist of two series,—the outer which is composed of sepals, collectively known as the calyx, and the inner which is composed of petals, collectively known as the corolla. The corolla is usually the showy part of a flower while the calyx is usually green in color. A flower which has calyx, corolla, stamens, and pistils is said to be *complete.* If any part is wanting it is *incomplete.* When both the floral envelopes are wanting it is *naked.* A flower in which the pistils are lacking is known as a *staminate flower,* while one in

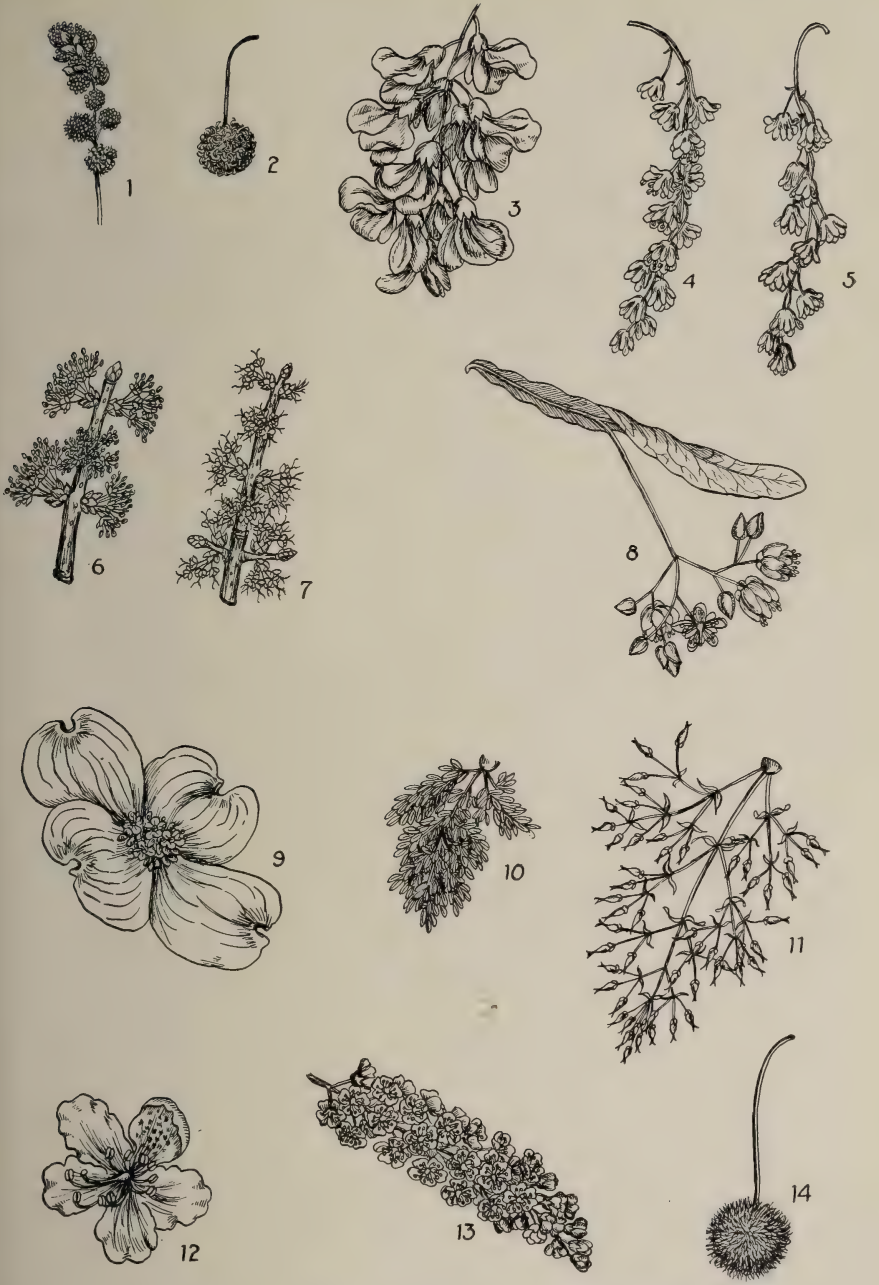

PLATE VIII. TYPES OF FLOWERS.

1. Sweet Gum (staminate heads), x ½.
2. Sweet Gum (a pistillate head), x ½.
3. Common Locust (a drooping raceme), x ½.
4. Striped Maple (a drooping staminate raceme), x ½.
5. Striped Maple (a drooping pistillate raceme), x ½.
6. Red Maple (staminate fascicles), x ½.
7. Red Maple (pistillate fascicles), x ½.
8. Basswood (a drooping cyme), x ½.
9. Flowering Dogwood (a dense cluster), x ½.
10. White Ash (a staminate panicle), x ½.
11. White Ash (a pistillate panicle), x ½.
12. Rhododendron (a single flower), x ½.
13. Wild Black Cherry (a raceme), x ½.
14. Buttonwood (a head), x ½.

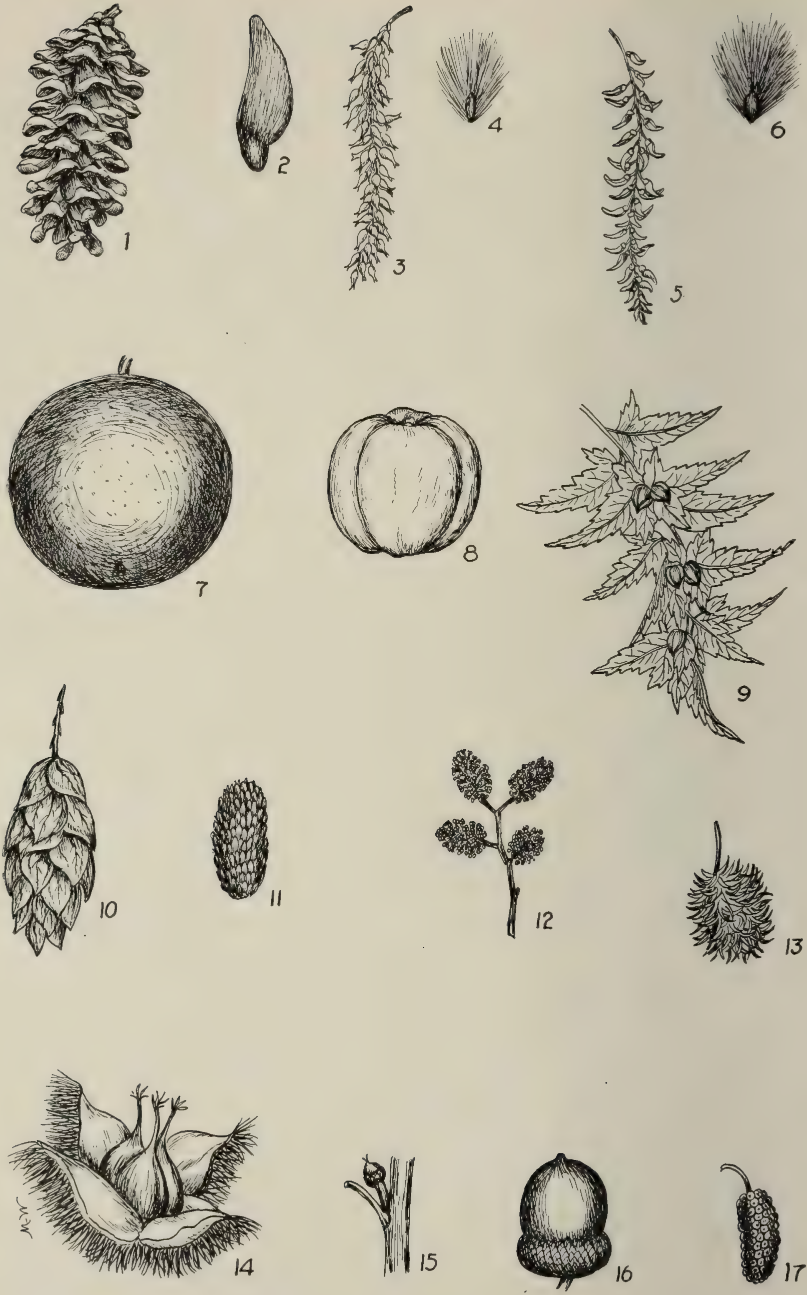

PLATE IX. TYPES OF FRUIT.

1. White Pine (cone), x ¼.
2. White Pine (winged seed), natural size.
3. Willow (capsules), x ½.
4. Willow (a winged seed), enlarged.
5. Trembling Aspen (capsules), x ½.
6. Trembling Aspen (a winged seed), enlarged.
7. Black Walnut (a nut with indehiscent husk), x ½.
8. Hickory (a nut with dehiscent husk), x ½.
9. American Hornbeam (a nut with 3-lobed bract), x ½.
10. American Hop Hornbeam (a nut inclosed in bladder-like bract), x ½.
11. Black Birch (a membranous strobile), x ½.
12. Black Alder (a woody strobile), x ½.
13. Beech (a nut with prickly bur), x ½.
14. Chestnut (a nut with spiny bur), x ½.
15. Red Oak (an immature acorn), x ½.
16. Red Oak (a mature acorn), x ½.
17. Red Mulberry (an aggregate fruit), x ½.

which the stamens are lacking is known as a *pistillate flower.* Sometimes the staminate and pistillate flowers are not only found on different parts of the same tree but on entirely different trees.

The chief role of flowers is pollination. Pollination is the transfer of pollen from the anther of the stamen to the stigma of the pistil. When pollen is transferred from the anthers to the stigma of the same flower it is known as *close-pollination,* and when pollen is transferred from the anthers of a flower of one plant to the pistil of a flower of another it is known as *cross-pollination.* Wind and insects are the chief agents which carry the pollen in the case of cross-pollination. The flowers of the Tulip Tree, Papaw, and Cherries, are examples in which close-pollination can take place, while the flowers of the Willows and Poplars are good examples in which cross-pollination takes place. When the staminate and pistillate flowers are on the same plants e. g. Oaks, American Hop Hornbeam, Beech, Chestnut, Hickories, and Walnuts, the plants are known as *monoecious* and when they are on different plants as in the Willows, Poplars, and occasionally some Maples, they are known as *dioecious.*

Flowers vary not only in the size, form, shape of their parts, and color, but also in their arrangement. In a few cases the flowers of trees like the Tulip Tree and Papaw are borne singly and known as *solitary flowers.* The flowers may also be arranged in clusters like that of the Lily of the Valley or the Wild Black Cherry (Plate VIII, 13). Such an inflorescence is known as a *raceme.* A raceme may be compact as in the Wild Black Cherry; or loose as in the Common Locust (Plate VIII, 3) and the Striped Maple (Plate VIII, 4-5). When the flower cluster is dense and the flowers sessile, or nearly so, it is known as a *spike.* Spikes may be 2-5-flowered as in the pistillate flowers of the Hickory (Plate VII, 8), or densely flowered as in the staminate flowers of the Mulberry (Plate VII, 18). A very short and dense spike is known as a *head* (Plate VIII, 14). A spike is sometimes short, flexible, and rather scaly as in the Willows, Poplars, and rather long as in the staminate flowers of the Oaks, Hickories, Birches, and Alders (Plate VII, 7, 9 and 15). Such a spike is known as an *ament* or *catkin.* Other types of inflorescence are the *umbels* (Plate LXXXVII), *panicles* (Plate VIII, 10-11), and *corymbs.*

The time at which the flowers appear and their duration varies with the species. The Alders, Hazlenut, and some Maples produce their flowers early in spring before the leaves are out. Others produce them with the leaves, while still others produce them after the leaves. The Witch-hazel produces its flowers late in fall. It is the last of our trees to blossom.

8. Fruit:

Sometime after pollination the egg cell or ovule is fertilized, and as a result of fertilization, the ovule, together with the surrounding ovary, enlarges. The enlarged ovules, together with inclosing ovary, form what is termed the fruit. The fruit may in addition comprise modifications of other organs intimately connected with the ovary.

Seeds are products of the flower and are usually regarded as reproductive organs, but in reality they are the result of reproduction. Their chief work is the dissemination and the protection of the offspring of reproduction. They are usually covered by hard and impermeable coats which protect the young plant contained within from the many dangers with which it is beset. Nature tries to guard against these dangers by developing suitable protective coverings for each species. Nature, however, is not always satisfied by simply developing a thick and impermeable coat, but in addition it develops an internal tissue which is compact and contains little water. If a seed possess these essentials it is well protected against most of the destructive agencies to which it is exposed. The chief dangers to which seeds are subject are premature germination, loss of vitality, and destruction by animals. Each seed usually has a suitable covering which regulates the germination in spring. This regulation is necessary so as not to allow the tender plant to emerge before the external growth conditions are favorable for its development. An embryo within a thin-coated seed would often be stimulated by a few warm days in spring with the consequence that the resulting tender plants would be killed by later frost. Nature acts as a guardian and places a thick coat around such embryos, and as a result they are not stimulated until later when frost danger is past.

Food is stored in various plant organs such as roots, stem, and branches, and is usually most abundant and conspicuous in the seeds. It occurs in various forms and may often differ in composition. Food stored in the seed is very valuable because it supplies nourishment to the small and tender plants before they have developed the roots with which they draw nourishment from the soil and supply water to the leaves where starch and sugar are manufactured. Primitive man obtained considerable food from the seeds of trees, and present man derives certain foods for himself and his animals from some of our common trees. The food value of seeds varies with the species. Some species like the Willows contain very little food, while others like the Chestnut are rich in food.

The time at which the fruit matures varies with the species. Willows, Poplars, and Elms mature their fruits in spring; others, like

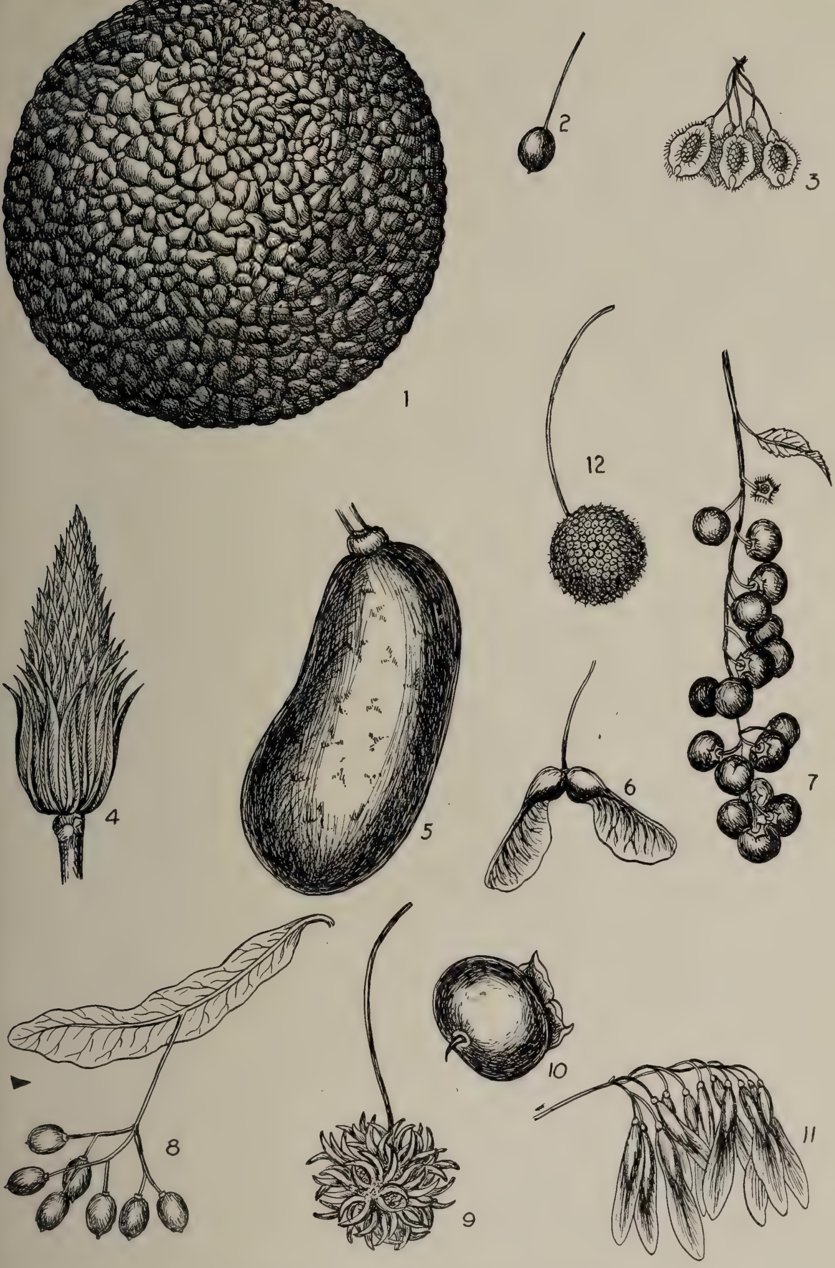

PLATE X. TYPES OF FRUIT.

1. Osage Orange (a compound drupe), x ½.
2. Hackberry (a drupe), x ½.
3. American Elm (one-seeded samara), x ½.
4. Tulip Tree (a light brown cone composed of many carpels), x ½.
5. Papaw (a fleshy or pulpy fruit), x ½.
6. Sugar Maple (paired samara), x ½.
7. Wild Black Cherry (a drupe), x ½.
8. Basswood (a nut-like drupe), x ½.
9. Sweet Gum (multicapsular head), x ½.
10. Persimmon (a juicy berry), x ½.
11. White Ash (samaras), x ½.
12. Buttonwood (a head), x ½.

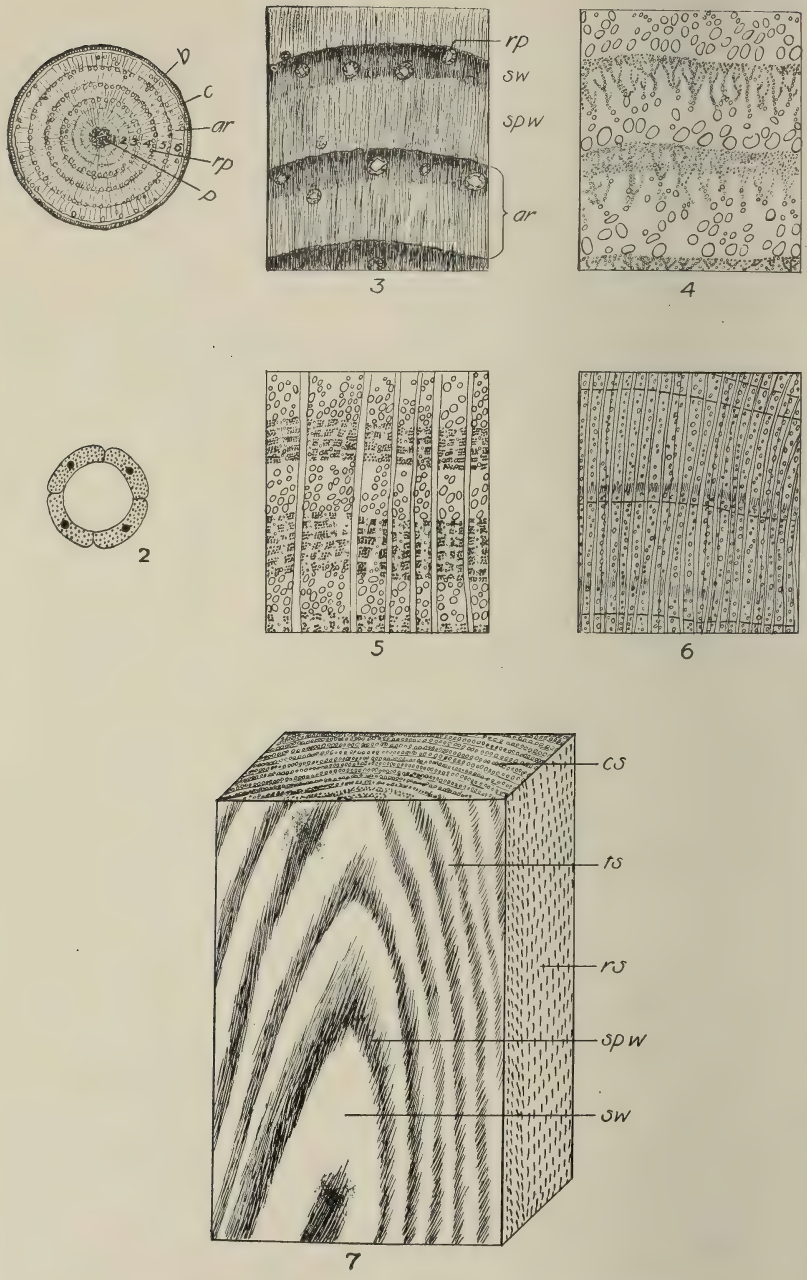

PLATE XI. THE STRUCTURE OF WOOD.

1. Cross section of six-year old stem of White Pine showing (b) bark, (c) cambium, (ar) annual ring, (p) pith, and (rp) numerous small circular resin passages, natural size.
2. A resin passage with bounding epithelial cells, enlarged.
3. Non-porous wood of White Pine showing (spw) spring wood, (sw) summer wood, (ar) annual ring, and (rp) resin passage, x 3.
4. Ring-porous wood of Chestnut, x 2.
5. Ring-porous wood of Red Oak, showing large medullary rays, x 3.
6. Diffuse-porous wood of Beech, x 4.
7. Block of Chestnut wood showing (cs) cross section, (rs) radial section, (ts) tangential section, (spw) spring wood, and (sw) summer wood, natural size.

the Cherries, Mulberries, and some Maples, in summer; but most of them, like the Oaks, Chestnut, Pines, and others, in autumn. The seeds of some species like the Willows die unless they germinate soon after they mature. Most species retain their capacity to germinate for several months or several years, while a few members of the Pulse family are reported to retain their vitality for more than 125 years.

The mature fruit and seeds of our common trees show a wide variation in their form and structure. Fruits are usually classified on the basis of their texture, as *fleshy fruits* and *dry fruits*. Fleshy fruits are represented by the fruits of such species as Cherries, Papaw, Osage Orange, etc. (Plate X, 1, 2, 5, 7, 10). Dry fruits are those which do not have any flesh or pulp, and are represented by the fruits of such species as the Maples, Ashes, and Oaks (Plate IX, 1-16, and Plate X, 3, 4, 6, 8, 9, 11, 12). Fleshy fruits including the stone fruits, are indehiscent. *Indehiscent fruits* (Plate X, 1, 2, 5, 7, 10) are those which do not split apart regularly along certain lines for the liberation of the seeds, while *dehiscent fruits* do split open. Dry fruits may be indehiscent or dehiscent.

The following general types of fruits are commonly recognized: the *pome* (Plate XCII), the *drupe* (Plate X, 7, 10), the *nut* (Plate IX, 7, 8, 9, 14, 15), the *samara* (Plate X, 3, 6, 11), the *follicle* (Plates LXXVI-LXXVIII), the *capsule* (Plate IX, 3, 5) and (Plate X, 9), the *legume* (Plates XCIV-XCVII), the *cone* (Plate IX, 1) and the *collective* or *aggregate* fruits, (Plate IX, 17). The species belonging to a single genus usually produce a common type of fruit, but genera belonging to the same family often have an entirely different kind of fruit. This difference of fruit of genera in the same family is shown very clearly in the Nettle family, to which belong the Elms, Hackberry, Osage Orange, and Mulberry, whose fruit are shown on Plate X, 3, 2, 1, and Plate IX, 17. A wide variation may also occur within the general types mentioned above. The nut is one of the commonest types of fruit found in the forest and will possibly show this wide variation best. Nuts may be small and light, as in the Buttonwood and Birches, or large and heavy as in the Oaks and Chestnut. Light nuts often have appendages attached to them in the form of a membranous wing or a tuft of hairs. The nuts may be produced singly or in strobiles as in the Birches and Alder. They may also be covered or naked. If covered, the covering may be indehiscent and semi-fleshy (Plate IX, 7), or dehiscent and dry (Plate IX, 8). It may also consist of a stalked prickly dehiscent bur (Plate IX, 13), a large spiny dehiscent bur (Plate IX, 14), a bladder-like bag (Plate IX, 10) or a leafy involucre, as in the Common Hazlenuts (Plate LI). In some species the seeds are not covered entirely but simply subtended by a leafy bract (Plate IX, 9).

In the Birches and Alder the small winged nuts are produced on 3-lobed bracts which are so arranged that they form a cone-like fruiting body known as a strobile. It is rather hard to classify the fruits of some species in terms of the types enumerated above, e. g., the fruit of the Basswood has the appearance of a nut, but is in reality a drupe; while the fruit of both the Mountain Ash and the Shad Bush has the appearance of a berry but is actually a pome. A superficial examination is often not sufficient to determine the type of fruit. The fruit of our common Sumachs is a drupe, but is usually covered with acid hairs, so that it is difficult to recognize the type of fruit to which it belongs.

After the fruits and seeds have been produced, it is necessary that they be scattered on a mineral soil upon which they may germinate. The distance over which they are scattered may be short or long, depending upon the nature of the seeds and the agents by which they are dispersed. The fruit, as a whole, is usually scattered in the case of indehiscent fruits, while the seeds only are scattered in the case of dehiscent fruits. The drawings on Plates IX and X show various structural modifications of fruits and seeds which aid in their dispersal. The chief dispersal agents are propulsion, man, animals, water. wind, and gravity. The Witch-hazel (Plate LXXXII), is a good example of a species whose seeds are scattered by mechanical propulsion. Man has been distributing seeds for forest trees intentionally or unintentionally for many centuries, with the result that the forest structure and landscape in many localities have been entirely changed. Many European and Asiatic species have been planted in America, and many of our native species like the Common Locust and White Pine have a wide distribution abroad. Wind is the most powerful of the dispersal agents. Many seeds have special structural modifications which adapt them to be scattered by the wind. The modifications may be a sac-like envelope (Plate IX, 10), a mat of straight capillary hairs (Plate IX, 4, 6) or a membranous winged, or flattened seed (Plate IX, 2 and Plate X, 3, 6, 11). Animals also scatter many seeds. A great number are scattered involuntarily by animals, especially such seeds as will hang fast to their bodies. Other fruits are juicy and edible and are often eaten by birds and other animals. A large number of our common birds swallow seeds to get the juicy edible portion surrounding them. These seeds are not injured in passing through the alimentary canal of birds, but in some cases it is thought that the seeds are even benefited. The robins, thrushes, and blue birds eat a large quantity of fleshy fruit and should be regarded as valuable agents for dispersing seeds. The blue jay is also an agent that helps to scatter heavy seeds like chestnuts and acorns. Other animals, especially rodents, are also valuable as seed dispersal agents. Water, while not so important as wind, must still be regarded as an agent of seed dispersal. It transports some seeds over great distances, especially those which will float or are inclosed in bladder-like inclosures like the American Hop Hornbeam (Plate IX, 10), or the Bladder Nut, a small shrub very commonly found along our streams. Gravity on slopes, is a minor agent of seed dispersal, but sometimes does effective work, especially with heavy seeded species like Oak and Beech.

9. WOOD:

Wood, next to food, and clothing, is probably the most useful and indispensable material which man uses. It is found in many of the higher plants but becomes of commercial importance only in the spermatophytes or seed-bearing plants. In the timber-producing trees it is found in the roots, branches, and stems. The wood derived from the roots is limited in quantity and inferior in quality. The branches produce wood which, in some respects, very closely resembles that of the stem, but is inferior on account of its smaller size, irregular shape, and more knotty structure. The wood obtained from the stem is of the greatest utility and value on account of its desirable dimensions and satisfactory structure. The stem should not only yield a large quantity of wood but also a superior quality. The quality of wood which a stem will yield depends largely upon its age, inherent tendencies of the species, and its environment during its development. High grade material is usually obtained from the stems of valuable species which have attained a large size, are free from lateral branches, and possess little stem taper. The form and character of the stem are dependent on the environment. A suitable environment may be created by applying the fundamental principles of forestry which will not only increase the productivity of our forests but also the quality of the yield.

In order to identify the different kinds of woods it is necessary to study them from the following three sections: cross, radial, and tangential (Plate XI, 7). An examination of a cross-section of a woody stem will show that the major part of the structure consists of wood which is covered with bark on the outside and has a narrow cylinder of soft tissue known as pith running through the center (Plate XI, 1).

The woody portion of most of our trees, especially the older ones, may be differentiated into two parts on the basis of colors. The central colored part is known as the *heartwood*, while the outer almost colorless part is known as the *sapwood*. A narrow zone of cells located between the sapwood and the bark is known as the *cambium* (Plate XI, 1). All the wood elements have their origin in this zone. For sometime after their origin these elements are living, but later they become functionless and die. The sapwood comprises the peripheral zone of wood which lies next to the cambium and contains the only living elements of the wood. The heartwood comprises all the wood inside of this zone. The elements of the latter are dead and usually dark in color. The line of demarcation between the two regions is usually sharp. The width of the sapwood is variable. In some species like Sassafras it is very narrow, while in other species like Hickory it is wide. The depth of color of the heartwood is also variable. In some species like Persimmon it is very dark in color while in other species like Hemlock there is very little difference in color between the heartwood and sapwood.

The cross-section also shows that the wood is divided into numerous concentric zones or rings. These are known as annual rings since each one usually represents the growth of a season (Plate XI, 1, 3). Certain disturbances like frost, drought, and insect damage may cause the formation of a second ring in the same season. These rings are known as false or fictitious growth rings. Growth rings have a physiological origin. They represent alternating periods of rest and activity, and occur in practically all trees of the temperate region, characterized by an active vegetative period in summer and a resting period in winter. As one approaches the equator the growth rings disappear, since the seasonal changes are not so sharp. Each growth ring may be divided into two parts, the inner, called *early* or *spring wood*, and the outer, called *late* or *summer wood* (Plate XI, 3).

The cross-section further shows radial lines crossing the growth rings at right angles. These are known as *medullary* or *pith* rays, or simply as *rays.* A few of them originate in the pith and extend through the wood into the bark. Such are known as *primary rays.* As the stem increases in size additional rays are necessary. These originate in the wood, extend into the bark and are known as *secondary rays.* The rays are very valuable in distinguishing the wood of many of our common trees since the different woods possess rays which vary in height, width, and structure. The very wide rays of the Oaks enable one to distinguish their wood from that of all other species. These large rays are a valuable asset to Oak wood since they give rise to the beautiful figure which one finds on some oak furniture and interior finishings. The best figure is obtained by quarter-sawing i. e. cutting it radially.

The end of a freshly cut log of pine is often covered with small drops of resin, which were given forth from small openings in the wood. These openings are known as *resin ducts* (Plate XI, 1, 2). They are long intercellular channels bounded by a layer of epithelial cells. Their presence in the wood of the Pines, Larches, and Spruces enables one to distinguish them from all other trees. Injury may sometimes stimulate the formation of abnormal resin ducts in woods in which they do not occur normally.

In some woods elements occur, known as vessels, which facilitate the transportation of water in the stem. Their presence or absence and their structure and distribution are among the most valuable characteristics in classifying woods. On the basis of porosity one may divide the woods into three classes, viz: (1) *Ring-porous* or *Unequal Pored,* (2) *Diffuse-porous* or *Equal Pored,* and (3) *Non-porous.* Chestnut and Oak wood are excellent examples of the ring-porous class (Plate XI, 4, 5). A zone of large pores is found in the early wood and smaller pores in the late wood. Maple and Beech are common examples of the diffuse-porous class (Plate XI, 6). The pores of this class are approximately of the same size and distributed uniformly throughout the growth ring. Pine and Hemlock are common examples of the non-porous class in which pores are entirely absent. (Plate XI, 3). The wood of this class is also classified as *Homogeneous,* while that with pores is classified as *Heterogeneous.*

The various woods possess other characteristics which are valuable in distinguishing them and in using them in the arts. The wood of the different species varies almost as widely as do their flowers, fruits, and leaves, especially with reference to grain, weight, hardness, color, gloss, smell, shrinkage, durability, penetrability, etc. These variable properties and the manifold uses to which the different woods are put are discussed under each species.

❧

PART II.

MANUAL OF PENNSYLVANIA TREES.

The Identification, Tabulation, and Description of Species.

⁂

MANUAL OF PENNSYLVANIA TREES.

IDENTIFICATION OF SPECIES.

NAMES OF TREES:

Trees have two kinds of names, common and scientific. Some species of trees have only one common name while others may have as many as thirty. The same species of tree may have one common name in one locality and an entirely different one in another locality. The Pitch Pine described on page 71 is known in some parts of this State as Jack Pine and in other parts as Nigger Pine. The common name given at the top of each descriptive page is the proper common name and the one used throughout this publication for that particular species. Under the heading "Distinguishing Characteristics," other common names are given.

Since Linnaeus published his "Species Plantarum" in 1753, plants have been known by scientific names. These names, as a rule, consist of two parts, the generic and the specific, as is shown by the following species of trees:— Pinus Strobus, Quercus alba, Fraxinus americana, Acer rubrum. The first or generic part refers to the genus and corresponds to a surname. The second or specific part refers not to a group of plants but to a particular kind and corresponds to the Christian name of a man. The White Pine, Red Pine, and Pitch Pine are different kinds of pines. They belong to the same genus or group and hence have the same generic name, Pinus. Each one, however, is designated by a different specific name. For example, the White Pine is known as Pinus Strobus, the Red Pine as Pinus resinosa, and the Pitch Pine as Pinus rigida. Closely related species are placed in the same genus and closely related genera (plural of genus) in the same family. Such closely related trees as the Pines, 'Spruces, Firs, and Larches, are placed in the Pine family—Pinaceae.

At the time when plants first were studied seriously the Latin language was the one used most commonly to preserve knowledge. The plants consequently were given Latin names. The giving of Latin names to plants and animals has continued down to the present time and no doubt will continue. In the Latin language one finds that plant-names have gender, and that the termination differs in each gender. The specific part of the name must agree in gender with the generic part. The generic name Quercus is feminine, hence the Red Oak is known as Quercus rubra while the generic name Acer is neuter, hence the Red Maple is known as Acer rubrum.

The scientific names used in this publication are those found in the Seventh Edition of Gray's Manual of Botany, and are in keeping with the rules of nomenclature laid down at a Congress in Vienna. On account of the present unsettled condition of our nomenclature it is often possible to find a certain species designated by two or more different scientific names, e. g., the Scrub or Bear Oak is known as Quercus ilicifolia, Wang.; Quercus nana, Sarg.; or Quercus pumila, Sudw. The authorized scientific name is given at the top of each descriptive page, and where other scientific names are in common use, they are given as synonyms just below the authorized one or in the description.

The mere knowledge of the names of trees is of little value or satisfaction. The name is simply a means by which to come nearer to the plant. Learning the names of trees serves about the same purpose as learning the names of persons. It is merely an introduction which allows us, in fact often stimulates us, to become more intimately acquainted with their life-processes, associations, environments, and commercial importance.

EXPLANATION OF TERMS AND HEADINGS:

Some readers no doubt will find terms in this publication whose meaning they do not know. Some of the terms have been discussed at length in Part I while others will be defined in a glossary following the description of the species. The description of the species of trees contained in this publication is subdivided into a number of headings. Most of these headings are discussed at length in Part I. The significance and scope of those headings not discussed in Part 1 will follow at this point. Under the several headings is given such descriptive material which will be of value not only to the student of Dendrology but also to the layman who may know little concerning the characters and habits of trees. The headings have been so selected and treated that one should be able to identify our common trees at all seasons of the year.

Under the heading "Distinguishing Characteristics" are given both general and specific characteristics by which the species can be recognized. The species are usually compared with other rather closely related ones with which they might be confused. The distinguishing characteristics and comparisons are based upon the trees native to Pennsylvania, and consequently do not embrace other closely related species found outside of the State.

The headings "Range" and "Distribution in Pennsylvania" are often of special importance on account of their identificational value. Many species of trees have a limit to their geographical distribution in this State, and by knowing this accurately one is often able to identify a species by the process of elimination. The Sweet Buckeye and Fetid Buckeye are found only in a few counties in the western part of the State. The Red Pine and Paper Birch are found only in the northern part, while the White Cedar is found only in a few counties in the extreme southeastern part of the State. If one finds a birch tree growing in the forest in the southern part of the State, he can feel certain that it is not Paper Birch, because this is beyond the southern limit of this species. A coniferous tree growing wild on the top of the South Mountains in Franklin county, Pennsylvania, must be a Pine, Hemlock, or Red Cedar, because no other coniferous trees grow there. Further we know that it cannot be the Red Pine, because this species does not extend so far south in the State, and on the basis of habitat we can also be reasonably sure that it is not the Yellow Pine, the Jersey or Scrub Pine, nor the Hemlock, because they very seldom ascend to the tops of the mountains, but usually remain at lower elevations. Likewise, if a maple tree is found at the same place we know that it is the Red Maple or Mountain Maple because they are the only Maples found in that particular locality. If Magnolia trees are found in Centre county one can be certain that the species is not Laurel Magnolia, (Magnolia virginiana), because this species has its western limit of geographical distribution at Caledonia, near Chambersburg, Franklin county. The habitat also aids considerably in identifying various species. A birch tree found growing upon a mountain slope or mountain top is rarely the River Birch, because the latter usually frequents moist locations like banks of streams and lakes. Chemical composition of the soil also influences distribution. A soil rich in lime seldom has Chestnut growing upon it, at least in stands, while other species seem to thrive upon such soil. No doubt at least 99% of the Cumberland Valley in this State was originally timbered with a heavy forest, but very little of it was Chestnut, while on the adjoining mountain slopes of both the South and North Mountains, Chestnut is the prevailing species. Just as the Chestnut is essentially a tree of the slopes so the White Oak is essentially one of the bottom lands, and Table Mountain Pine of the mountain tops.

The heading "Importance of the Species" was introduced simply to give general information concerning the forestal significance of the species and their adaptability for ornamental purposes. This heading is especially important when we realize that of the more than one hundred and twenty-five species of trees found in this State, fewer than twenty-five are important for timber-producing purposes. Many inferior species which have little present or prospective value have been introduced into this publication, since it was thought just as important to know what not to plant as to know what to plant. Some species may not be valuable for the production of timber but they may have a value as shelter to other species or as soil protectors and soil conservers. Many species which cannot be regarded as final members of a timber-producing forest may be of temporary value in helping to establish the more valuable permanent species. We should be cautious in eliminating the inferior species from our forest structure, because they may possess a value which is not evident at the present time. It should be remembered that the species despised by myself may be prized by my neighbor, and that the species despised today by my neighbor and myself may be prized by both of us tomorrow. Only general statements are made with reference to the importance of the species. A fuller discussion of this heading may be found in any standard text on General Forestry or Silviculture.

How to Identify the Species and Use the Keys:

Since this publication is intended primarily for laymen and for students who are just beginning the study of trees, the omission of technical terms was thought advisable. We have many species of trees, some common, others uncommon, which the average layman may not know. He can learn them readily if their distinguishing characteristics are presented to him in ordinary language accompanied by simple and exact drawings. This publication is designed so that the average layman with even a limited knowledge concerning trees can use it and identify the various species with little, if any, difficulty.

The procedure or method of identification varies with the individual. One may take material from a tree and compare it with the drawings until he finds one with which it corresponds or to which it fits, and then feel satisfied that he has learned to know the tree. To check himself and to acquire additional information he may read over the descriptive material accompanying each plate. This method of comparison with plates, while the one commonly used by laymen who have little or no working knowledge concerning trees, is laborious and entirely unscientific. A better and yet simple method is the use of an analytic key for the identification of the species. Such keys according to their construction may be simple or complex, serviceable or unserviceable to the average layman. In constructing the subjoined analytic key, an attempt was made to make it simple and yet exact, based upon permanent rather than transient, and constant rather than variable characteristics. This publication will no doubt come into the hands of different classes of people, some of whom will recognize at a glance the genus to which a certain tree belongs, while others will not have the slightest idea as to what it is. An attempt has been made to satisfy both types of persons. The former can go at once to that portion of the publication where the genus under consideration is treated and by the use of the "Key to the Species" determine the exact species which they have at hand, while the latter should begin at the "Key to the Families" found on page 63, and use the key until the family to which it belongs is found, then go to the family and use the "Key to the Genera" and the "Key to the Species" until the species is determined. With a little practice one will find it easy to use such simple keys.

Before attempting to use a key, it is necessary that good material be available. Parts of trees vary considerably, depending upon the environments in which they were developed. An abnormal environment will produce abnormal organs, and if these should be the parts with which you are attempting to identify the species through the use of the keys, it is natural that it would be a difficult task. Structural variations are commonly found in leaves, flowers, fruit, bark, as well as other plant organs. Upon the same tree or even the same branch one may find three or more distinct varieties of leaves. On account of this variation, which often makes identification difficult, abundant material should always be at hand, and especially that which is normal in appearance. The keys are based upon normal material and may not fit variable forms. Only by years of constant and careful study of trees will one be able to distinguish accurately between normal and abnormal material; but by carefully observing and constantly studying the trees one will unconsciously absorb many details concerning them which can be appreciated but not described. This unconscious absorption of appreciable but indescribable detail in trees has a greater significance than we attribute to it at first. The writer, in conducting field work (Fig. 7) for five years in connection with a course in Dendrology given at the Pennsylvania State Forest Academy, finds that the students learn to notice many differences between species, which differences they cannot describe.

The keys are subdivided into three classes, viz: "Key to the Families," "Key to the Genera" and "Key to the Species." The "Key to the Families" is found on page 63, preceding the description of any of the species. The "Key to the Genera" is found under the description of each family which contains more than one genus; and the "Key to the Species" is found under such genera which contain more than one species. The reason for subdividing the keys into three classes instead of combining all three into a general key to genera and species, was the fact that a combined key is often difficult to use on account of its great length, and tedious to operate for those who can recognize the family or genus at a glance but do not know the species. Besides, keys to the genera and keys to the species are more serviceable when placed close to the written description and its accompanying plate than if they precede the descriptive material of all the species.

The three classes of keys are constructed on the same plan; consequently, they can be used in the same manner. To use them it is necessary to make a choice for the most part between two alternatives stated in two paragraphs preceded by the same number. The choice leads to another number or to a family, a genus or a species followed by the page upon which a further description is found. The Sugar Maple may be taken as an example to show how to use the key. Under "Key to the Families," page 63, we start with 1. We have the choice between trees with "Leaves narrow, needle-like, awl-like, or scale-like, usually persistent except in the genus Larix" and trees with "Leaves broad, flat, rarely five times as long as wide, usually deciduous." We select the latter, which is followed by 2. Under 2 we have the choice between "Leaves opposite or whorled, i. e. 2 or 3 occur at a node" and "Leaves alternate, i. e. only one occurs at a node." We choose the former, which is followed by 3. Here we have the choice between "Leaves or at least most of them three at a node" and "Leaves always two at a node." We select the latter, which is followed by 4. Here we have the choice "Leaves simple" and "Leaves compound." We select the former, which is followed by 5. Here we have the choice between "Leaves palmately lobed" and "Leaves not lobed." We select the former, which is followed by Aceraceae, which is the family name for the Maples. This is followed by a number which indicates the page upon which a further description of the family may be found. At this point it is advisable to check one's self. This can be done by carefully studying the descriptive matter of the family indicated in order to find out if the description corresponds to the species under consideration. If the description does not correspond it is advisable to go back to the "Key to the Families" and attempt to find the mistake. If the description does correspond it is reasonable to think that the "Key to the Families" was used correctly. If you feel certain that this is the correct family you should go to the "Key to the Genera," or to the "Key to the Species." No "Key to the Genera" is given under this family because it contains only one genus. Under the "Key to the Genera" and the "Key to the Species" the same method of procedure should be used that was used under the "Key to the Families." On account of the wide variation between the distinguishing characteristics which are present in summer from those which are present in winter, it has sometimes been found necessary to make two keys to the species, one a summer key and the other a winter key. Two such keys are found under the Maple family. If the material at hand happens to be a spray of leaves of the Sugar Maple, the summer key should be used, and if it happens to be a branchlet with buds, the winter key should be used.

Since the family key which was used to this point was based primarily upon summer characteristics, the winter key will now be used in order to familiarize you with the slight variations which are found between the two keys. Under "Winter Key to the Species," page 191, we start with 1. Under 1 we have the choice between "Buds stalked with few exposed scales" and "Buds sessile or nearly so, with 6 or more exposed scales." We select the latter, which is followed by 4. Under 4 we have the choice between "Buds with 8-16 exposed scales, brown, acute, non-collateral; leaf-scars nearly encircle stem" and "Buds with 6-8 exposed scales, red or green, obtuse." We select the former which is followed by Sugar Maple (Acer saccharum) page 194. On this page a full description of the species is found accompanied by a sketch on the opposite page of the principal characteristics. If the descriptive material and the sketches show that this is the species under consideration, one may feel satisfied that the key has been used properly. If the description does not correspond it is advisable to go back to the beginning of the key, follow the same procedure indicated above but eliminating the mistake which must have been made. The same method of identification or procedure should be used for every other species. In a short time one will be familiar enough with the use of the key to identify the species and will do so with considerable accuracy.

If you cannot identify the specimen at hand with the aid of the keys, description, and plates, there are still other means which you may use. It may be possible that an institution or a private person n your part of the State possesses an herbarium in which may be ound a similar specimen properly labeled. If you can get access to uch an herbarium and find that your specimen and the one in the herbarium are alike, and that the herbarium specimen was labeled by a reliable person, it is reasonable to assume that you have identified your specimen correctly. It may also be possible that some one onnected with some local educational institution will be able to asist you in identifying the material. All material sent to the Dendrological Department of the Pennsylvania State Forest Academy, Mont Alto, Pa., will be identified free of charge. Persons sending material should always aim to send an abundance of it. If flowers, leaves, fruits, and bark are obtainable they should all be sent.

The wider the range of material the easier and the more accurate the identification will be.

Those who desire to collect and preserve material should proceed in the same manner as one would in making general botanical collections. The dried material may be secured on strong mounting paper. The writer has found the "Riker Specimen Mounts" very satisfactory for preserving and displaying the different parts of trees. Different sizes are obtainable, which allows one to select them in proportion to the size of the material to be preserved.

GENERAL KEY TO THE FAMILIES.

	Page.
1. Leaves narrow, needle-like, awl-like, or scale-like, usually persistent except in the genus Larix, ...Pinaceae	67
1. Leaves broad, flat, rarely five times as long as wide, usually deciduous, ...2	
2. Leaves opposite or whorled, i. e., two or three occur at a node, ...3	
2. Leaves alternate, i. e., only one occurs at a node, ...10	
3. Leaves, or at least most of them, three at a node, ...Bignoniaceae	211
3. Leaves always two at a node, ...4	
4. Leaves simple, ...5	
4. Leaves compound, ...8	
5. Leaves palmately lobed, ...Aceraceae	190
5. Leaves not lobed, ...6	
6. Leaves serrate, ...Viburnum in Caprifoliaceae	218
6. Leaves entire, ...7	
7. Leaves 3-6 inches long with curving parallel veins; bases of leaf stalks enlarged, encircling twigs, ...Cornus in Cornaceae	204
7. Leaves 4-8 inches long without curving parallel veins; bases of leaf stalks do not encircle twigs, ...Chionanthus in Oleaceae	217
8. Leaves palmately compound, ...Sapindaceae	200
8. Leaves pinnately compound, ...9	
9. Leaflets usually 5-11; finely toothed or entire margined, ...Fraxinus in Oleaceae	212
9. Leaflets usually 3, sometimes 5-lobed or coarsely serrate, ..Acer Negundo in Aceraceae	197
10. Leaves simple, ...11	
10. Leaves compound, ...40	
11. Leaves persistent, ...12	
11. Leaves deciduous, ...14	
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12. Leaves armed with spiny teeth, ...Ilex opaca in Aquifoliaceae	188
13. Small trees; leaves stout, white silky beneath, not taper pointed; flowers solitary, ...Magnolia virginiana in Magnoliaceae	156
13. Shrubs; leaves leathery, yellowish-green to scurfy beneath, often taper pointed; flowers in clusters, ...Rhododendron and Kalmia in Ericaceae	207
14. Leaves with entire margins, ...15	
14. Leaves with toothed, lobed, or incised margins, ...23	
15. Leaves broadly heart-shaped; flowers reddish-purple, shaped like pea blossoms; fruit a pea-like pod, ...Cercis in Leguminosae	180
15. Leaves not broadly heart-shaped; flowers not shaped like pea blossoms; fruit not a pea-like pod, ...16	
16. Stout axillary spines present; fruit 3-5 inches in diameter,......Maclura in Urticaceae	153
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17. Leaves not aromatic or lobed; twigs not spicy-aromatic, nor mucilaginous, ...18	
18. Leaves 2-6 inches long; flowers small except pistillate of Diospyros, not solitary, ...19	
18. Leaves more than 6 inches long; flowers large and solitary, ...22	
19. Leaves bristle-tipped, linear-lanceolate to oblong; pith star-shaped; fruit an acorn.... Quercus imbricaria and Q. phellos in Fagaceae	146
19. Leaves oval-ovate or obovate, not bristle-tipped; pith not star-shaped; fruit a drupe or a berry, ...20	

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20. Leaves thin, clustered at tip of twigs, with prominent curved parallel veins; small trees; twigs greenish streaked with white, ...**Cornus alternifolia in Cornaceae** 205
20. Leaves thick, not clustered at the tip of twigs; veins not parallel; medium sized trees; twigs not greenish, ...**21**

21. Leaves 4-6 inches long; leaf petioles with one fibro-vascular bundle; fruit a globular berry 1-1½ inches in diameter, ...**Ebenaceae** 210
21. Leaves 2-5 inches long; leaf petioles with 3 fibro-vascular bundles; fruit a purple ovoid drupe ¾ of an inch long, ...**Nyssa in Cornaceae** 206

22. Stipules and stipule-scars encircle twigs; flowers greenish-white or yellowish; fruit cone-like; twigs often aromatic and bitter, ...**Magnoliaceae** 155
22. Stipules absent; flowers reddish-purple, ill-smelling; fruit banana-like, edible; twigs not aromatic or bitter, ...**Anonaceae** 160

23. Leaf margins usually lobed or incised, ...**24**
23. Leaf margins usually toothed, ...**29**

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24. Leaves not star-shaped, ...**25**

25. Leaves silvery beneath, ...**Populus alba in Salicaceae** 94
25. Leaves not silvery beneath, ...**26**

26. Leaves rough on upper surface, with milky juice, ...**Morus in Urticaceae** 154
26. Leaves not rough on upper surface, without milky juice, ...**27**

27. Leaves decidedly aromatic, lobed or entire; twigs spicy-aromatic, mucilaginous,........ **Lauraceae** 161
27. Leaves not aromatic; twigs not spicy-aromatic nor mucilaginous, ...**28**

28. Leaves palmately veined; base of leaf petioles hollow; leaf lobes irregularly toothed. **Platanaceae** 175
28. Leaves pinnately veined; base of leaf petioles not hollow; leaf lobes rounded or bristle-pointed, intervening spaces deep or shallow, ...**Most species in Fagaceae** 124

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29. Leaves not with an oblique base, ...**32**

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30. Leaves rounded, heart-shaped, or obovate; smooth on upper surface, ...**31**

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32. Leaves not dentate nor coarsely toothed, ...**34**

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34. Fruit fleshy, ...**37**

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37. Thorns or spine-like spurs present, ... **Prunus americana, Pyrus coronaria, and Crataegus sp. in Rosaceae** 164
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TABULATION OF GENERA AND SPECIES.

Families, Genera, etc.	Species.			
			Pennsylvania.	
	World.	North America.	Native.	Introduced.
Gymnospermae.				
Fam. I. Pinaceae.				
Gen. 1. Pinus,	70	34	6	1
Gen. 2. Larix,	10	3	1	1
Gen. 3. Picea,	19	8	2	2
Gen. 4. Abies,	25	10	1	....
Gen. 5. Tsuga,	8	4	1	....
Gen. 6. Chamaecyparis,	6	3	1	....
Gen. 7. Thuya,	4	2	....	1
Gen. 8. Juniperus,	40	16	2	....
Angiospermae.				
Fam. II. Salicaceae.				
Gen. 9. Salix,	175	100	4 (15)*	3
Gen. 10. Populus,	27	19	4	4
Fam. III. Juglandaceae.				
Gen. 11. Juglans,	15	5	2	1
Gen. 12. Carya,	15	15	5 (1)	1
Fam. IV. Betulaceae.				
Gen. 13. Corylus,	7	3	1 (1)	....
Gen. 14. Ostrya,	4	2	1	....
Gen. 15. Carpinus,	12	1	1	....
Gen. 16. Betula,	25	15	5	1
Gen. 17. Alnus,	25	10	1 (1)	....
Fam. V. Fagaceae.				
Gen. 18. Fagus,	5	1	1	1
Gen. 19. Castanea,	5	3	2	....
Gen. 20. Quercus,	300	55	16	....

Families, Genera, etc.	Species.			
	World.	North America.	Pennsylvania.	
			Native.	Introduced.
Fam. VI. Urticaceae.				
Gen. 21. Ulmus,	15	6	2	1
Gen. 22. Celtis,	60	9	1	....
Gen. 23. Maclura,	1	1	....	1
Gen. 24. Morus,	10	3	1	1
Fam. VII. Magnoliaceae.				
Gen. 25. Magnolia,	25	8	3	....
Gen. 26. Liriodendron,	1	1	1	....
Fam. VIII. Anonaceae.				
Gen. 27. Asimina,	8	8	1	....
Fam. IX. Lauraceae.				
Gen. 28. Sassafras,	2	1	1	....
Fam. X. Hamamelidaceae.				
Gen. 29. Hamamelis,	3	1	1	....
Gen. 30. Liquidambar,	3	1	1	....
Fam. XI. Platanaceae.				
Gen. 31. Platanus,	7	3	1	1
Fam. XII. Rosaceae.				
Gen. 32. Pyrus,	40	10	2 (4)	....
Gen. 33. Amelanchier,	30	23	1 (3)	....
Gen. 34. Crataegus,	700	60	2 (14)	....
Gen. 35. Prunus,	90	43	4 (10)	8
Fam. XIII. Leguminosae.				
Gen. 36. Gymnocladus,	2	1	1	....
Gen. 37. Cercis,	7	3	1	....
Gen. 38. Gleditsia,	11	3	1	....
Gen. 39. Robinia,	7	7	2	....
Fam. XIV. Simarubaceae.				
Gen. 40. Ailanthus,	7	1	....	1
Fam. XV. Anacardiaceae.				
Gen. 41. Rhus,	120	16	3 (3)	....
Fam. XVI. Aquifoliaceae.				
Gen. 42. Ilex,	275	22	2 (3)	....
Fam. XVII. Aceraceae.				
Gen. 43. Acer,	70	13	6	2
Fam. XVIII. Sapindaceae.				
Gen. 44. Aesculus,	15	7	2	1
Fam. XIX. Tiliaceae.				
Gen. 45. Tilia,	20	8	2	....
Fam. XX. Araliaceae.				
Gen. 46. Aralia,	30	15	1 (3)	....
Fam. XXI. Cornaceae.				
Gen. 47. Cornus,	40	15	2 (6)	....
Gen. 48. Nyssa,	7	5	1	....
Fam. XXII. Ericaceae.				
Gen. 49. Rhododendron,	100	10	1	....
Gen. 50. Kalmia,	6	6	1 (2)	....
Gen. 51. Oxydendrum,	1	1	1	....
Fam. XXIII. Ebenaceae.				
Gen. 52. Diospyros,	160	2	1	....
Fam. XXIV. Oleaceae.				
Gen. 53. Fraxinus,	40	16	3 (2)	....
Gen. 54. Chionanthus,	2	1	1	....
Fam. XXV. Bignoniaceae.				
Gen. 55. Catalpa,	7	2	....	2
Fam. XXVI. Caprifoliaceae.				
Gen. 56. Viburnum,	100	20	2 (8)	....
Total,	2,819	661	113 (76)*	29

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*The numbers given in parenthesis refer to species native to Pennsylvania but not described and rarely mentioned in this publication.

THE PINE FAMILY—PINACEAE.

There is general agreement that the Pine and Yew families comprise the two divergent branches of the conifers which differ from each other in morphological characters and geographical distribution. The conifers comprise 34 genera and about 300 species, of which number 8 genera with 71 species belong to the Yew family (Taxaceae) and 26 genera with 226 species to the Pine family (Pinaceae). The representatives of these two families are found mainly in temperate regions, both northern where the genus Pinus predominates, and southern where the genus Podocarpus predominates. The geographical distribution of these two families is peculiar since the genera of the northern temperate region are not found in the southern and those of the southern are not found in the northern, excepting the two genera (Heyderia and Podocarpus) which cross the tropics. Geological records together with the simplicity of floral structure show us that the members of this family are amongst the oldest living representatives of the ancient arborescent type of vegetation. Morphological evidence seems to point to the belief that the Yew family contains representatives of the most primitive form of conifers and that the genus Pinus in the Pine family contains the most highly specialized forms. The sole representative in Pennsylvania of the family Taxaceae is the American Yew or Ground Hemlock (Taxus canadensis, Marsh.) It is a small evergreen shrub seldom exceeding 5 feet in height.

The Pine family is of especial economic value on account of the many commercial products which are obtained from it and the wide range of silvicultural characteristics which its members possess. The annual wood production of the members of this family in the United States far surpasses that of the members of any other family. The wood differs markedly from that of the broad-leaved trees in its greater uniformity, smaller porosity, and less conspicuous medullary rays. Some members of this family yield large quantities of resin, tar, turpentine, and pitch. The fruit of some species is often of considerable importance as food, and the bark of many species is used in the process of tanning.

The members of the Pine family have awl-shaped, scale-shaped, or needle-shaped entire leaves, which are usually persistent. The American Larch is the only coniferous species native to Pennsylvania which is without foliage in winter. The subjoined key gives the characteristics of the genera commonly found in Pennsylvania:

KEY TO THE GENERA.

Page

1. Fruit a dry cone with winged seeds, ...2
1. Fruit a fleshy, round, dark-colored berry with bony seeds, ...Juniperus 8

2. Leaves linear to needle-shaped, not closely overlapping; cone-scales numerous; buds scaly, ...3
2. Leaves scale-like, closely overlapping; cone-scales few; buds not scaly, ...7

3. Leaves in bundles of two or more except on young seedlings and on terminal twigs of Larix, ...4
3. Leaves solitary, ...5

4. Leaves persistent, 2-5 in each bundle, ...Pinus 6
4. Leaves deciduous, more than 5 in each cluster, ...Larix 7

5. Leaves flattened, whitish on lower surface, ...6
5. Leaves 4-angled, needle shaped, ...Picea 7

6. Leaves with leaf-like stalks, about 2/5 of an inch long; twigs rough; cones small with persistent scales, ...Tsuga 8
6. Leaves without leaf-stalks, usually 4/5 of an inch or more in length; twigs smooth; cones large with deciduous scales, ...Abies 8

7. Leaves less than ⅛ of an inch long; twigs rather slender, not prominently flattened; cones globular with shield-shaped scales which do not overlap, ...Chamaecyparis 8
7 Leaves ⅛ of an inch or more in length; twigs rather prominently flattened; cones elongated with 8-12 overlapping scales, ...Thuja 8

THE PINES—PINUS (Tourn.) L.

This genus comprises more species than any other belonging t the Pine family. About 70 species are known in the world, 34 o which are found in North America and 6 in Pennsylvania. Of th 34 species in North America, 13 are found in the eastern part an 21 in the western part. Besides the native Pines a number of exoti species have been planted extensively for ornamental, and locall for forestry purposes. The commonest exotic species are Scotc Pine (Pinus sylvestris, L.) and Austrian Pine (Pinus Laricio va austriaca, Endl.).

The Pines are adapted to a wide range of climate and soil. Ce tain species may be found bordering streams and lakes or close t the ocean front while others are confined to mountain tops wher they ascend to the timber line. This adaptability makes some o the species of considerable economic value even though they ma produce no wood of commercial importance. They can be used fo afforesting mountain slopes where protection forests are to be forme and maintained, and to reclaim sand barrens.

The Pines are generally trees, rarely shrubs, and of considerabl commercial importance on account of the excellent quality and larg quantity of major and minor forest products which they yield. Se eral species of Pine have always been foremost in the estimation lumbermen and the public since the American Forests began to be exploited. Until recently more pine lumber has been produced annually in the United States than all other kinds of lumber combined. The lumber-producing pine trees have played a very important role in our economic and industrial development. The Pines are distinguished commercially into two classes, Soft Pines and Hard Pines. In the United States there are 12 species of Soft Pine, and 22 species of Hard Pine. The White Pine is the sole eastern representative of the Soft Pines, while the Hard Pines have 12 representatives in the eastern and southern United States.

The Pines have three kinds of leaves: seed, primary, and secondary leaves. The primary leaves soon disappear and are seldom seen except on seedlings. The secondary leaves occur singly or in clusters of 2 to 5 and often have a persistent or deciduous sheath surrounding them at the base. They are semi-circular or triangular in cross-section, depending upon the number which occur in a cluster. The flowers usually appear in spring. The staminate are borne at the base of the season's growth in clusters and produce enormous quantities of sulphur-like pollen. The pistillate occur near the terminal part of the new shoot or laterally along it, solitary or in whorls of 2-5 or more. Prior to pollination they normally stand erect but after this process has been completed they begin to droop. The wind is the chief agent of pollination. Fertilization takes place about 13 months after pollination. The result of these processes is usually a cone which matures at the end of the second or sometimes the third season. The cones are composed of numerous scales at the base of which the seeds are produced in pairs.

KEY TO THE SPECIES.

			Page.
1.	Leaves 5 in a sheath, slender, with 1 fibro-vascular bundle,	P. Strobus	70
1.	Leaves fewer than 5 in a sheath, usually stout, with 2 fibro-vascular bundles,	2	
2.	Leaves 3 in a sheath,	P. rigida	71
2.	Leaves 2 in a sheath,	3	
3.	Leaves 5-6 inches long; cones subterminal, scales unarmed,	P. resinosa	72
3.	Leaves less than 5 inches long; cones lateral, scales armed with spines or prickles,	4	
4.	Cones 2½-3½ inches long, armed with stout spines; leaves very sharp-pointed and stiff,	P. pungens	73
4.	Cones 3 inches or less in length, armed with prickles; leaves slender to slightly stiff,	5	
5.	Leaves slender, straight, occasionally 3 in a sheath, 4 inches long or less,	P. echinata	74
5.	Leaves stout, twisted, 1½-3½ inches long,	6	
6.	Twigs smooth, greenish-purple to grayish-brown; cones at right angles to branch	P. virginiana	75
6.	Twigs rough, dull grayish-yellow; cones pointing backward; bark of upper third of trunk reddish; European species,	P. sylvestris	76

WHITE PINE.

Pinus Strobus, Linnaeus.

FORM—At present seldom exceeding 3 ft. in diameter and 125 ft. in height, usually 50-90 ft. high and 1½ to 3 ft. in diameter. When grown in dense stands (Figs. 1 and 10) the trees are tall, straight, free from lateral branches for a considerable distance from the ground, have little stem-taper and shallow crowns. When grown in the open (Fig. 34, specimen on left), it has much stem-taper, is relativley low, often forked, covered with persistent lateral branches almost to the ground which make it attractive ornamentally but of low commercial value.

BARK—On young branches, thin, smooth, greenish-brown; later scaly and darker. On old trees thick, dark gray, and divided by long and shallow fissures into broad longitudinal ridges (See Fig. 44.)

TWIGS—Slender, flexible, at first hairy, slightly roughened by raised leaf-scars. New growth at first light green and erect. During first winter light brown in color, less erect in position, very resinous if punctured.

BUDS—In terminal cluster, ovate-oblong, sharp-pointed, with numerous brown, long-pointed and overlapping scales. Apical bud ¼-½ of an inch long. Lateral buds about ¼ of an inch long.

LEAVES—Light green when young and bluish-green, soft, flexible, 2½-5 inches long when mature; persist usually until end of second season, occur in clusters of five, are triangular in cross-section, contain one fibro-vascular bundle, have finely serrate edges and are surrounded at the base by a deciduous sheath.

FLOWERS—Appear about May. Staminate flowers clustered at base of new growth of season, yellow, oval, about ⅓ of an inch long. Pistillate flowers solitary or in small groups, lateral along new growth, pinkish-purple, cylindrical, about ¼ of an inch long.

FRUIT—A cone maturing in two seasons, 5-10 inches long, drooping, stalked, slightly curved, and covered with thin unarmed scales without thickened apex. Seeds are winged, ¼ of an inch long, dark brown in color on both sides and mottled with black spots.

WOOD—Non-porous; resinous, soft, straight-grained, easily worked, light brown except sapwood which may be almost white. Weighs 24.04 lbs. per cubic foot. Formerly used for a wider range of purposes than any other native species and adapted for practically all uses except where strength, hardness, flexibility and durability in contact with soil are required.

DISTINGUISHING CHARACTERISTICS—The White Pine is the only species of Pine native to eastern North America which has soft, flexible, bluish-green needles in clusters of five. The lateral branches, usually 3-7 in a whorl, are arranged in distinct horizontal layers. The cones are 5-10 inches long, long-stalked, and their cone-scales are thin, flat, and unarmed.

RANGE—Newfoundland to Manitoba on the north, south through northern states to Pennsylvania and along the Allegheny Mountains to Georgia, and southwest to Iowa.

DISTRIBUTION IN PENNSYLVANIA—Common in the mountainous portion of the State. Originally formed heavy stands especially in the central and northern parts of the State. Sometime pure but usually mixed with other species. Found sparingly in the southwestern and southeastern parts. Rarely found at present in valleys like the Cumberland, Lancaster, Chester, lower Lehigh, and lower Delaware.

HABITAT—Prefers a fertile, moist, well-drained soil, but will grow well on dry sandy, soils and gravelly slopes. Common on banks of streams, river flats, in hollows and ravines, but rarely found in swamps. Any habitat in its natural range will be favorable to its development except swamps and ridges exposed to severe winds.

IMPORTANCE OF THE SPECIES—White Pine is one of the most important timber trees of the United States. It is indigenous to America but was introduced into England by Lord Weymouth in 1705 and shortly afterwards into Germany where it is no longer regarded an exotic species but a naturalized member of the German forest. This species can be recommended for forestry purposes, because it may be regenerated successfully both naturally and artificially as shown by the numerous and extended German experiments. It adapts itself to a great variety of soil conditions, is a rapid grower, is very attractive ornamentally, and will thrive in pure or mixed stands; but the latter are best on account of less danger from disease, better natural pruning, and earlier financial returns from thinnings.

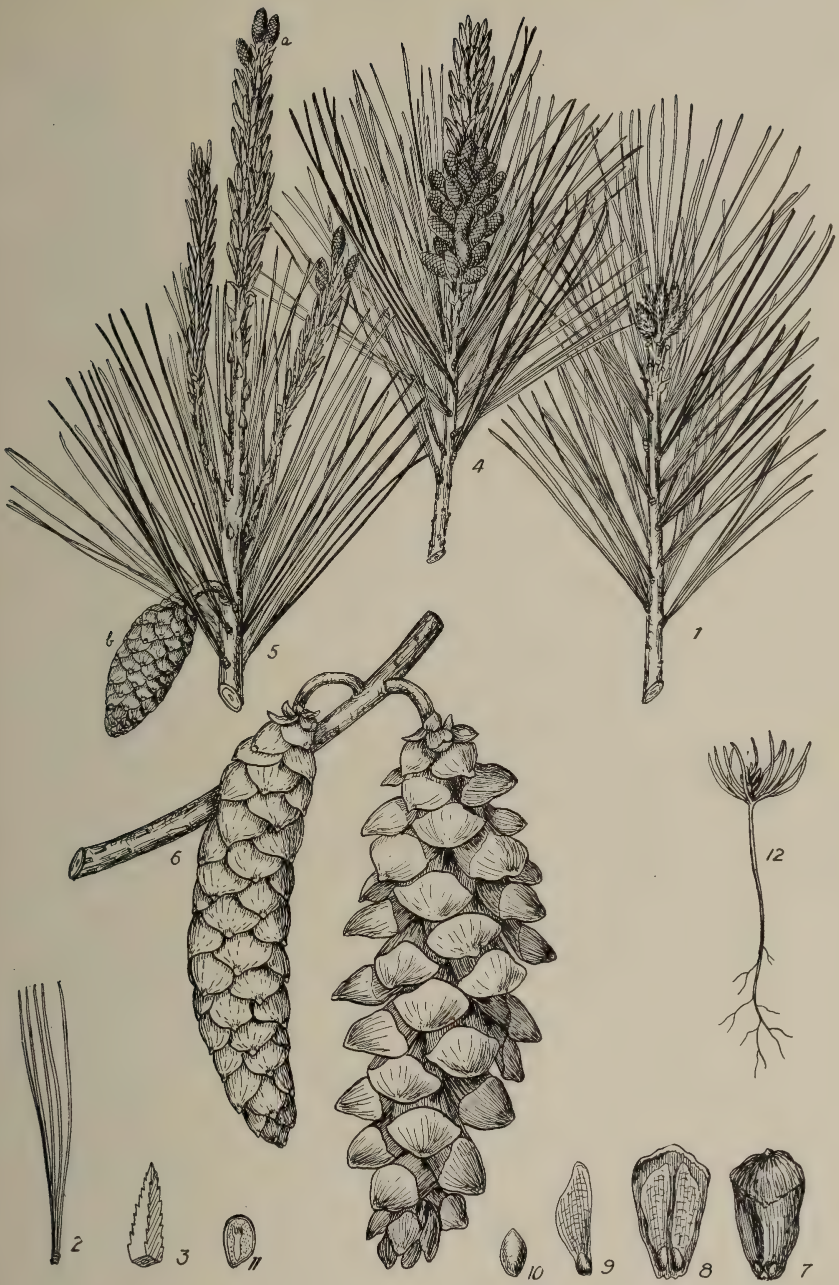

PLATE XII. WHITE PINE.

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of five needles, x ½.
3. Tip of needle with sharply serrate margin, enlarged.
4. Branch with staminate flowers, x ½.
5. Branch with (a) pistillate flowers on new growth (b) one-year old cone on last season's growth, x ½.
6. Branch with an open and a closed cone, x ½.
7. Lower side of a cone scale, x ½.
8. Upper side of a cone scale with two winged seeds, x ½.
9. A winged seed, x ½.
10. A seed, natural size.
11. Section of seed with embryo, natural size.
12. A seedling, x ½.

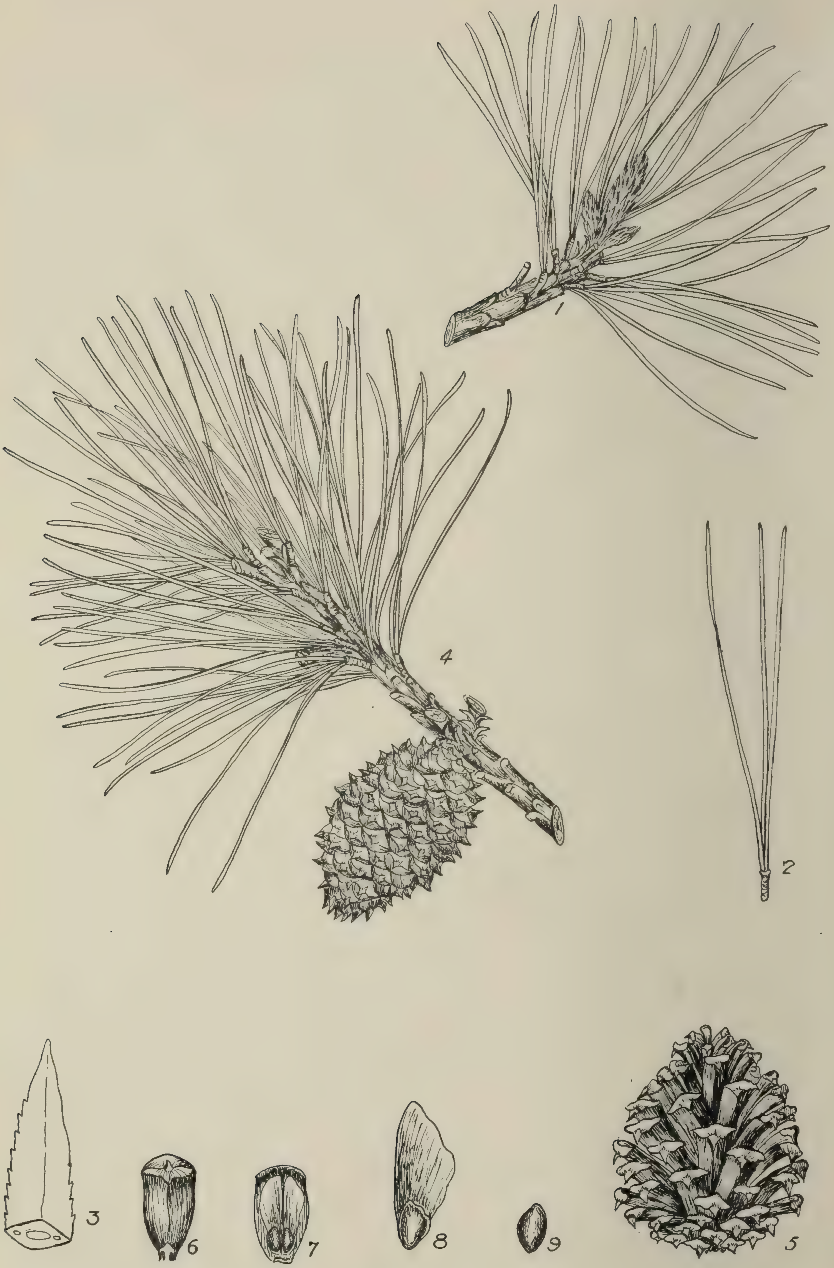

PLATE XIII. PITCH PINE.

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of three needles, x ½.
3. Tip of a needle with serrate margin, enlarged.
4. Branch with needles and a closed cone, x ½.
5. An open cone, x ½.
6. Lower side of a cone scale, x ½.
7. Upper side of a cone scale with two winged seeds, x ½.
8. A winged seed, natural size.
9. A seed, natural size.

PITCH PINE.

Pinus rigida, Miller.

FORM—Usually attains a height of 40-50 ft. and a diameter of 1-2 ft. and seldom exceeds 70-80 ft. in height and 3½ ft. in diameter. Trunk rather tapering except in occasional pure and closed stands. Open grown trees have an irregular wide pyramidal crown. Branches numerous, irregular, gnarled, often drooping, and covered by small plate-like scales and numerous persistent cones. Crown is often so irregular and scraggy in appearance that it becomes picturesque.

BARK—On young branches green and smooth soon becoming yellowish, later grayish-brown and roughened by persistent bases of the bud-scales. On young trunks roughened with reddish-brown scales, with age becoming rougher through deep furrows and flat ridges which separate into thin reddish-brown scales. The scales sometimes appear black, whence the name Nigger Pine. See Fig. 46.

TWIGS—Stout, brittle, smooth, brown and very rough on account of persistent elevated and decurrent bases upon which the leaf-clusters rested.

BUDS—Ovate, sharp-pointed, often resinous, ¼-¾ of an inch long, covered with imbricated, loose, brown, and shining scales.

LEAVES—In sheathed clusters of 3, stout, rigid, dull-pointed, closely and sharply toothed, at first light green, later yellowish-green, 2½-5 inches long, with stomata on all sides, and contain 2 fibro-vascular bundles and 3-7 resin-ducts.

FLOWERS—Appear in April or May. Staminate flowers clustered at base of new growth of season, are cylindrical, yellow, ½ of an inch long, and produce an enormous amount of pollen. Pistillate flowers solitary or clustered, lateral on new growth, at first green, later tinged with red.

FRUIT—A cone maturing in 2 seasons, 1½-3½ inches long, sessile or short-stalked, ovate, occurs solitary or whorled, often stands at right angles to the branch, and persists for 10 or more years. Cone scales thickened at apex, armed with short rigid recurved prickles. Seeds winged, dull or glossy black, sometimes mottled with gray or red dots.

WOOD—Non-porous; resinous, light, brittle, coarse-grained, rather durable, brownish-red with abundant lighter sapwood. Weighs 32.10 lbs. per cubic foot. Used for railroad ties, charcoal, mine props, fuel, sometimes for construction timber and lumber.

DISTINGUISHING CHARACTERISTICS—The Pitch Pine, also known as Jack Pine and Nigger Pine, is the only native Pine of Pennsylvania with leaves in sheathed clusters of 3. The Yellow Pine may occasionally have the needles in clusters of 3, but usually 2. Pitch Pine has a very irregular and scraggy appearance due to the dead and gnarled branches which are often covered with clusters of persistent cones. The bark is thick and irregularly fissured with intervening flat ridges which separate into thin reddish-brown sometimes black scales. Trunks are often fire scarred. Such trunks are frequently covered with dense mats or clusters of leaves and short branches.

RANGE—New Brunswick to Lake Ontario on the north, south to Virginia and along mountains to Georgia, and west to western New York, Kentucky and Tennessee.

DISTRIBUTION IN PENNSYLVANIA—Found in practically all parts of the State. Occurs in excellent pure stands at the base of the South Mountains in Franklin county, and in Pike county. In many regions it occurs only as a scattered tree mixed with hardwoods.

HABITAT—Common on dry burned-over areas, sterile plains, gravelly slopes, rocky cliffs, and sometimes found in swamps. In the glaciated area it is common on rocky glacial soil.

IMPORTANCE OF THE SPECIES—From a commercial point of view this species is not so important as the White Pine or the Red Pine, but it is gradully growing in importance since new uses are found for the wood and prices of other woods are rising. Silviculturally it is valuable on account of its adapatability to poor soil and its fire resisting qualities. These qualities recommend it for reforesting neglected or fire endangered lands on mountain slopes as well as low sandy areas. It may not be the species ultimately desired upon the area, but may act as a shelter during the establishment of a stand of a more valuable species.

RED PINE.

Pinus resinosa, Aiton.

FORM—Usually from 50-75 ft. in height with a diameter of 2-3 ft. but reaching a maximum height of 140 ft. with a diameter of 4½ ft. In closed stands trunk is straight, tall, slightly-tapering, and free from lateral branches for a considerable distance from the base while in open stands the lateral branches extend nearly to the base and the trunk is often branched and strongly-tapered. Crown usually broad, irregular, pyramidal, with dark green foliage tufted at the ends of the branches. See Fig. 42.

BARK—Reddish-brown, ¾-1¼ inches thick, divided by shallow furrows into broad flat ridges which peel off in thin scales. See Fig. 45.

TWIGS—Stout, slightly roughened by persistent bases of bud-scales; at first yellowish-brown, later reddish-brown.

BUDS—Ovoid, pointed, ¼-¾ of an inch long. Bud-scales brown, thin, loose, and fringed on the margin.

LEAVES—In sheathed clusters of 2, 4-6 inches long, dark green, rather slender and flexible, sharp, persisting for 3-5 years.

FLOWERS—Appear in May. Staminate flowers about ½ of an inch long, occur in dense clusters at base of growth of season, have dark purple anthers. Pistillate flowers subterminal, 2 to 3 in a whorl, short-stalked, scarlet.

FRUIT—A cone about 2 inches long, nearly sessile, light brown, ovate-conical when closed and somewhat spherical when open, persisting until the following year. Cone-scales chestnut-brown with ends slightly thickened and transversely ridged but not armed with spines or prickles.

WOOD—Non-porous; resinous, hard, pale red, with thin light sapwood, and very conspicuous medullary rays. Weighs 30.25 lbs. per cubic foot. Green wood is very heavy and will sink. Used for heavy construction, piles, masts, in general for nearly all other purposes for which White Pine is used.

DISTINGUISHING CHARACTERISTICS—The Red Pine, also known as Norway Pine, is essentially a northern tree and is the only native Pine of Pennsylvania with needles 4-6 inches long, sheathed in clusters of 2. Its cones are about 2 inches long, subterminal, and bear scales which are not armed with spines or prickles. The needles are borne in tufts at the ends of branches.

RANGE—Distinctly a northern tree occurring from Nova Scotia and Quebec on the north to Pennsylvania on the south, and west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Found only in the northern part of the State. Its southern limit in the central part of the State is about at Williamsport. In the eastern and western parts it does not come so far south as in the central part.

HABITAT—Usually found on dry gravelly ridges, mountain-tops, and dry sandy plains. Rare on flat lands with wet clay soil.

IMPORTANCE OF THE SPECIES—The Red Pine is a valuable timber tree usually mixed with other species of trees but occassionally found in dense pure stands in Minnesota. This tree is remarkably well adapted to natural seed regeneration since it produces a great quantity of light, large-winged seeds which are readily disseminated by the wind and does not shed all its seeds at the same time. It readily adapts itself to variable conditions, is attractive ornamentally, and should be regenerated naturally where seed trees are at hand and artificially upon such areas where other more valuable trees will not grow.

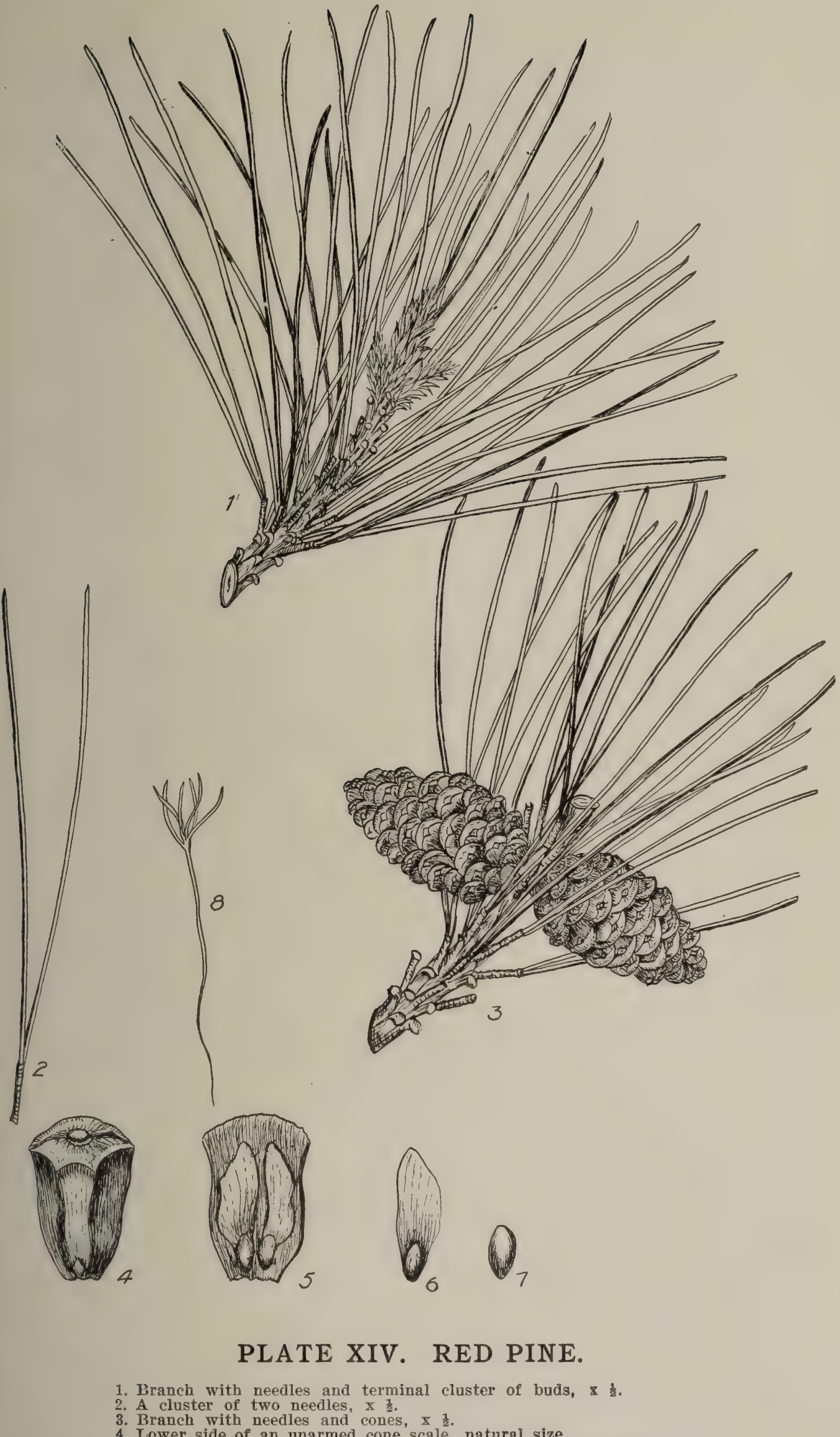

PLATE XIV. RED PINE.

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two needles, x ½.
3. Branch with needles and cones, x ½.
4. Lower side of an unarmed cone scale, natural size.
5. Upper side of a cone scale with two winged seeds, natural size.
6. A winged seed, natural size.
7. A seed, natural size.
8. A seedling, x ½.

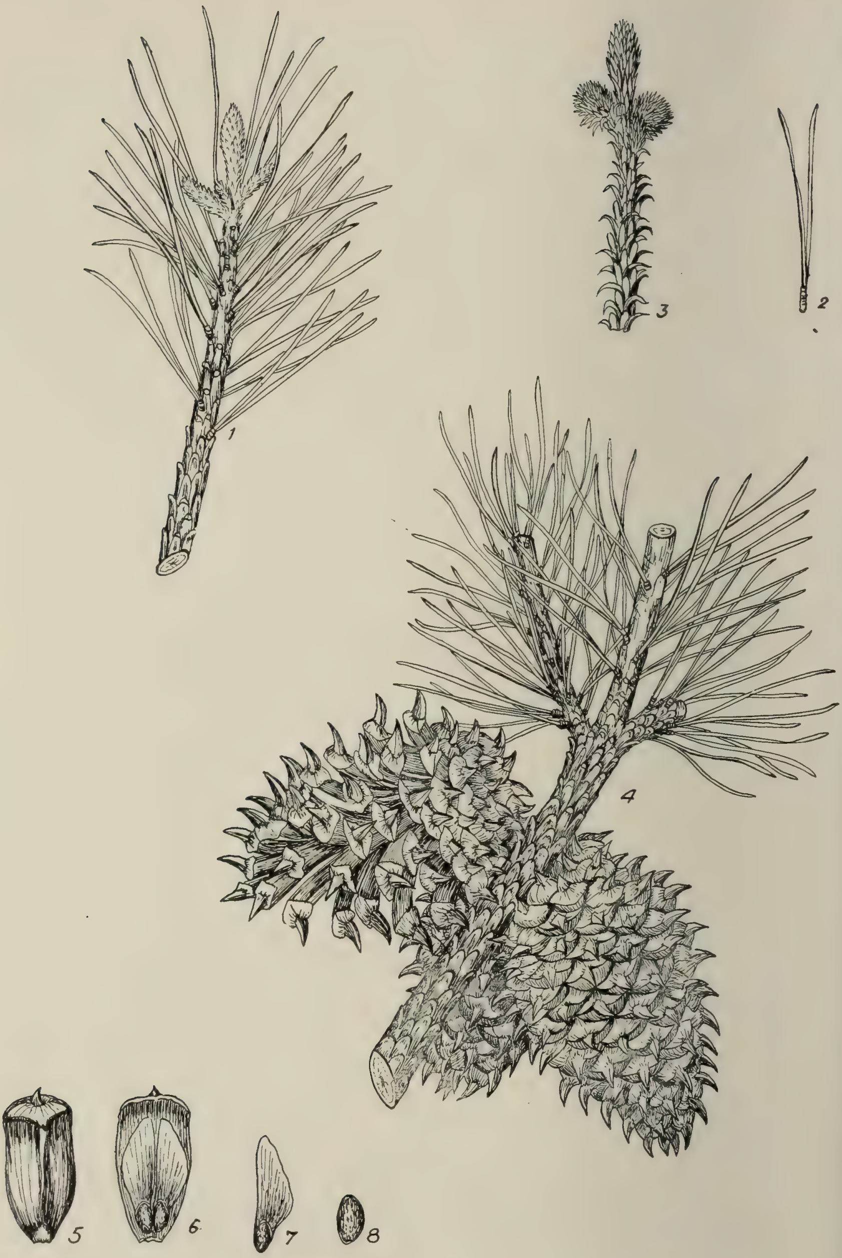

PLATE XV. TABLE MOUNTAIN PINE.

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two stiff, twisted and sharp-pointed needles, x ½.
3. New growth with two pistillate flowers, x ½.
4. Branch with needles and a whorl of three cones, x ½.
5. Lower view of a cone scale with a spine, x ½.
6. Upper view of a cone scale with two winged seeds, x ½.
7. A winged seed, x ½.
8. A seed, natural size.

TABLE MOUNTAIN PINE.

Pinus pungens, Lambert.

FORM—Usually attains a height of 30-40 ft. with a diameter of 1-2 ft., but when crowded in a closed forest stand it may attain a height of 60 ft. with a diameter of 2½-3 ft. Crown in closed stands shallow, irregular, narrow, and round-topped. In the open the trunk is short, bearing short lateral branches, the upper ones ascending and the lower ones drooping. Often the tree is covered with branches to the base of the trunk so that the lower branches lie prostrate on the ground. See Fig. 43.

BARK—Dark reddish-brown, ½-¾ of an inch thick, roughened by shallow fissures into irregular plates which peel off in thin films.

TWIGS—Stout, rather brittle, at first smooth and light orange to purplish, later rather rough and dark brown.

BUDS—Resinous, narrowly elliptical, blunt-pointed, covered with overlapping brown scales. Terminal buds about ½-¾ of an inch long, the lateral shorter.

LEAVES—In clusters of 2 surrounded by a persistent sheath, 2-4 inches long, light bluish-green, stout, very stiff, more or less twisted, very sharp-pointed, tufted at the end of the branches, persisting for 2-3 years.

FLOWERS—Appear in April or May. Staminate flowers occur in long, loose clusters at the base of the growth of the season; have yellow anthers. Pistillate flowers appear laterally along new growth in whorls of 2-5 or 7, and are very short and stout-stalked.

FRUIT—A cone 3-4 inches long, sessile, oblique at the base, in whorls of 2-5 or 7 or even more, light brown, short ovoid, persisting for 15 or more years but shedding seeds soon after maturity. Cone-scales, especially those near base, much thickened and provided with a strong curved spine. A branch 7 years old, 1½ inches thick at the thickest end and 3½ ft. long bore 36 cones. Trees 5 years old and 2-3 ft. tall can be found which bear developing cones.

WOOD—Non-porous; resinous, brittle, coarse-grained, pale reddish-brown with light sapwood. Weigh 30.75 lbs. per cubic foot. Used primarily for fuel and charcoal, and occasionally sawed into lumber.

DISTINGUISHING CHARACTERISTICS—The Table Mountain Pine, also known as Poverty Pine, can readily be distinguished by its coarse and massive cones armed with very stout curved spines. The cones appear usually in whorls of 3, 5, 7 or more and persist for many years. The stout, twisted, and very sharp-pointed needles are also characteristic.

RANGE—From Pennsylvania and New Jersey along the mountains to North Carolina and northern Georgia.

DISTRIBUTION IN PENNSYLVANIA—Sparse to abundant upon the mountains in the south-central part of the State and extends northeast on the mountains to Schuylkill county. It is primarily a southern species which occurs in pure stands on the mountains in Franklin county. Common on some mountains in Fulton, Blair, Huntingdon, Mifflin, Perry, and Union counties. Small outposts of it are also reported from Lancaster and York counties.

HABITAT—Commonly found on dry, rocky, and gravelly slopes. Occasionally found at the base of the mountains on somewhat moist clayey soil.

IMPORTANCE OF THE SPECIES—The lumber obtained from this tree is of little commercial importance on account of its small size and the numerous knots which it contains. It is a very aggressive species and is adapted for the regeneration of worn-out fields as well as to protect rocky slopes and prominences from erosion. It occasionally reaches a size which will yield lumber. Trees 20 inches in diameter and with a clear length of 25 feet are not uncommon locally in the southern part of the State.

YELLOW PINE.

Pinus echinata, Miller.

FORM—Attains height of 80-100 ft., occasionally 120 ft. and diameter of 2-3 ft., occasionally 4 ft. Crown shallow, wide, pyramidal or rounded. Trunk clean, tall, and slightly tapering. Lateral branches relatively light, very brittle, intolerant of shade, and consequently drop off very early producing the clean, tall, and stately trunk. See Figs. 11 and 34.

BARK—On young branches at first pale green and smooth, later reddish-brown and scaly. On old trees dark brown tinged with cinnamon-red, often ¾-1 inch thick, broken by distinct fissures into irregular, often rectangular plates which peel off very readily into numerous thin filmy scales. See Fig. 47.

TWIGS—Stout, brittle, slightly rough, at first often covered with glaucous bloom, later becoming reddish-brown.

BUDS—Ovoid, dull-pointed, covered with sharp-pointed dark brown scales.

LEAVES—Usually in clusters of 2 sometimes 3 or even 4, slender, flexible, faintly toothed, abruptly pointed, dark bluish-green, 3-5 inches long, surrounded by persistent sheath, and persisting for 2-5 years.

FLOWERS—Appear in April or May. Staminate flowers clustered at base of new growth of season, nearly sessile, pale purple. Pistillate flowers rarely solitary, but usually 2-4 in a whorl just below end of new growth, borne on stout erect stems, and pale rose colored.

FRUIT—A cone maturing in 2 seasons. One year old cones short-stalked, oval, about 1/6-¼ of an inch long. Mature cones short-stalked or sessile, conic when closed and ovoid when open, 1½-2 inches long, often persisting for 2 or more years. Cone-scales have slightly enlarged ends terminated by weak or deciduous prickles. Seeds small, triangular, 3/16 of an inch long, ⅛ of an inch wide, pale brown mottled with black spots.

WOOD—Non-porous; resinous, hard, strong, with distinct spring and summer wood, yellowish or dark brown. Weighs 38.04 lbs. per cubic foot. It furnishes the most desirable of the yellow pine lumber of commerce and is largely manufactured into lumber used for general construction and carpentry.

DISTINGUISHING CHARACTERISTICS—The Yellow Pine, also known as Short-leaf Pine, is rarely found in the northern part of Pennsylvania which will prevent confusing it with the Red Pine native only to the northern part of the State. It can be distinguished from the other species of Pine found growing with it in this State by its rather slender flexible leaves in sheathed clusters of 2, sometimes 3 or 4, its conic cones with scales terminated by weak or deciduous prickles, its brittle branchlets, and its clean, stately, slightly-tapering trunk, the bark of which is marked off by deep furrows into irregular or rectangular plates which peel off very readily into numerous thin film-like scales.

RANGE—Southeastern New York and northern Pennsylvania to Florida, westward to Illinois, Kansas and southeastern Texas.

DISTRIBUTION IN PENNSYLVANIA—This is essentially a southern species but extends into Pennsylvania. It is usually mixed with hardwoods. Large specimens of it are found in the Benjamin George tract (Fig. 11) near Mont Alto, Franklin county. It is also reported on the Cook tract in Jefferson and Forest counties, and in Fulton, Lancaster, Perry, Lycoming, and Union counties.

HABITAT—Common on poor, sandy, or clayey soil. It is a tree of the plains and foothills. Reaches its optimum development on the uplands and undulating plains west of the Mississippi. In the east it is usually mixed with hardwoods.

IMPORTANCE OF THE SPECIES—Next to the Long-leaf Pine this species is the most important of the Southern Pines. It is destined to play a very important role in future forest management in the regions where the conditions of growth are favorable, on account of its economic and commercial value. This species, on account of the ease with which it regenerates naturally, requires little assistance from the hands of the forester. It can be planted upon favorable situations anywhere in Pennsylvania.

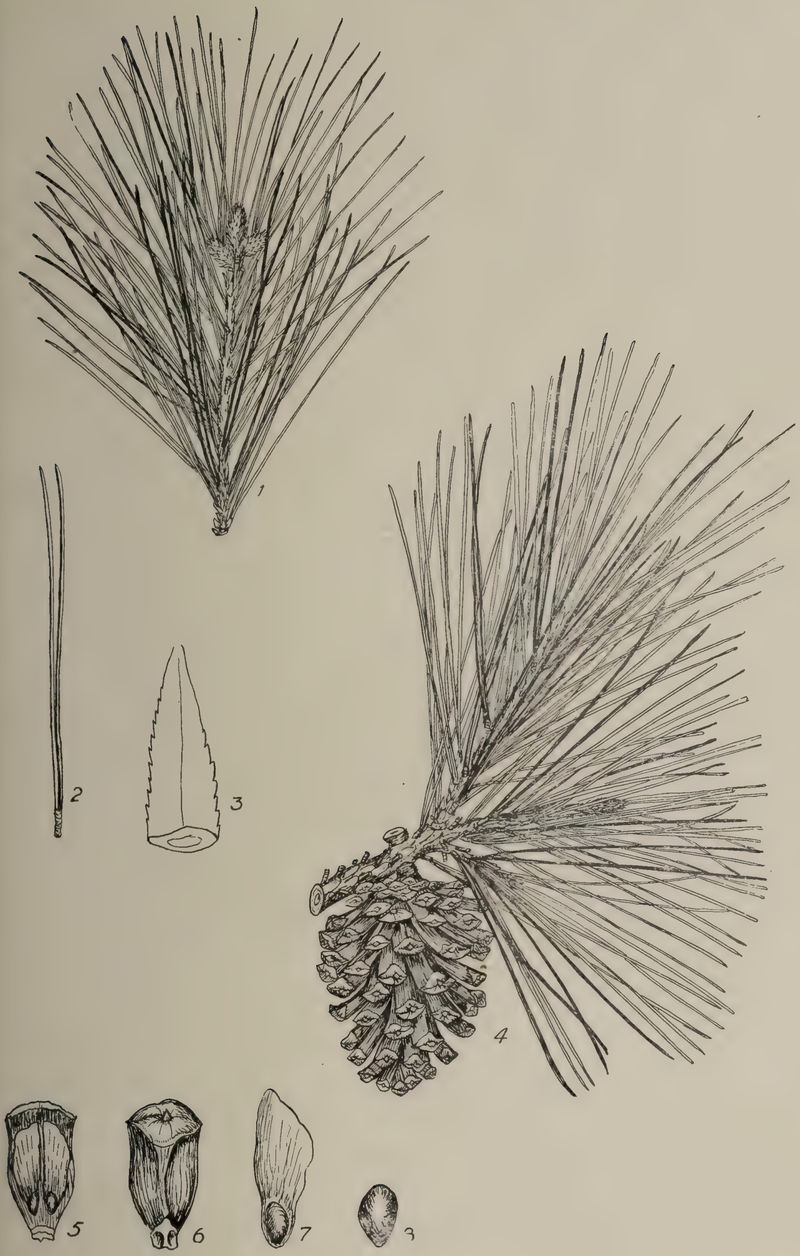

PLATE XVI. YELLOW PINE.

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two needles, x ½.
3. Tip of needle with serrate margin, enlarged.
4. Branch with needles and an open cone, x ½.
5. Upper side of a cone scale with two winged seeds, x ½.
6. Lower side of a cone scale, x ½.
7. A winged seed, natural size.
8. A seed, slightly enlarged.

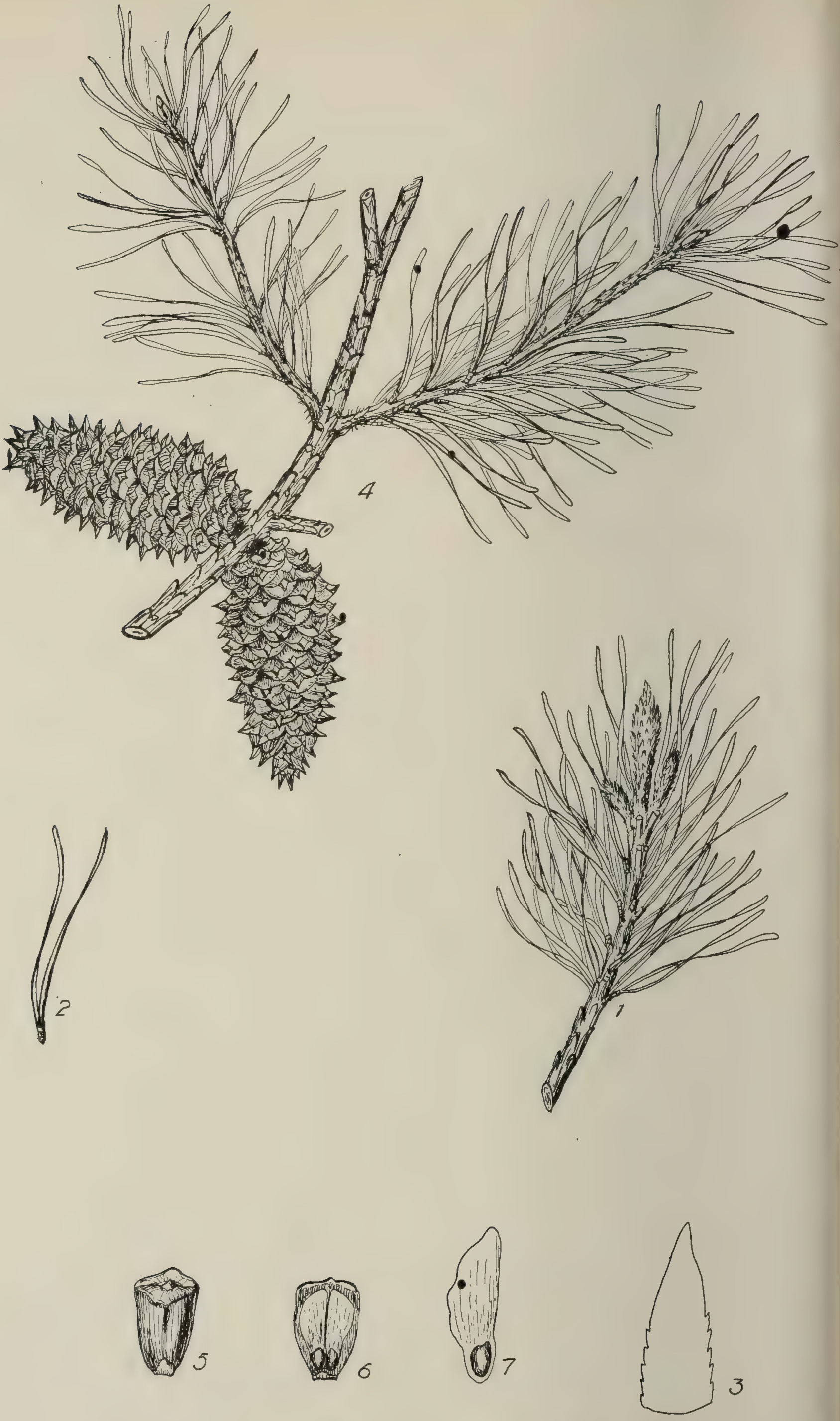

PLATE XVII. JERSEY OR SCRUB PINE.

1. Branch with needles and terminal cluster of buds, x ½.
2. A cluster of two needles, x ½
3. Tip of a needle with serrate margin, enlarged.
4. Branch with needle and closed cones, x ½.
5. Lower side of a cone scale, x ½.
6. Upper side of a cone scale with two winged seeds, x ½.
7. A winged seed, natural size.
8. A seed, natural size.

JERSEY OR SCRUB PINE.

Pinus virginiana, Miller.

FORM—Usually attains a height of 30-40 ft. with a diameter of 18 inches, but reaches larger dimensions, especially in Indiana. Trunk usually short since the long horizontal or pendulous branches cover it almost to the base. Young trees have a pyramidal form while older trees develop a rather flat-topped conic form.

BARK—On the trunk ¼-½ of an inch thick, dark reddish-brown, shallowly fissured into small flat plates separating into thin film-like scales. Smoother than that of our other native Pines. See Fig. 48.

TWIGS—Slender, tough, flexible, rather smooth, at first greenish-purple and covered with a glaucous bloom, later light grayish-brown.

BUDS—Ovate, sharp-pointed, ¼-½ of an inch long, covered with overlapping, sharp-pointed, brown scales.

LEAVES—In clusters of 2 with persistent sheath, 1½-3 inches long, twisted, bright green, rather stout, fragrant, sharply thick-pointed, finely toothed, divergent above the sheath, and closely dispersed on twigs.

FLOWERS—Appear in April or May. Staminate flowers crowded at base of growth of season, ⅓ of an inch long, oblong, with yellowish-brown anthers. Pistillate flowers appear near the middle of the season's growth and are long-stalked, sub-globose, solitary, or few in a whorl.

FRUIT—A cone, 2-3 inches long, usually sessile, sometimes slightly curved, conical when closed and ovoid when open, seldom persisting for more than 3 or 4 years. Cone-scales thin, nearly flat, thickened at apex, and terminated with a prickle. Seeds rounded, ⅓ of an inch long, ⅛ of an inch wide, and pale brown.

WOOD—Non-porous; slightly resinous, light, soft, brittle, pale orange, with very light sapwood. Weighs 33.09 lbs. per cubic foot. Used for fuel, and to some extent for railroad ties and lumber.

DISTINGUISHING CHARACTERISTICS—The Jersey or Scrub Pine can be distinguished by its short, twisted, and divergent needles distributed in pairs along the smooth, purple, and tough branchlets. The cones are small, with thin rather flat scales and provided with slender prickles. The divergent and twisted needles closely dispersed on the twigs give rather a disheveled appearance to them, and permits one to distinguish this tree at a distance since the light of the background is diffused through it so evenly. The bark is smoother than in the other native species of Pine.

RANGE—Southeastern New York and Pennsylvania, south to Georgia and Alabama, west to Indiana and Kentucky.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the southern part of the State. It is primarily a southern species and extends as far north as Allegheny county in the western part, Clinton and Lycoming counties in the central part, and Northampton county in the eastern part. In Franklin county it is usually found at the base of the mountains, seldom ascending the mountains or extending into the valley.

HABITAT—Common on light sandy or poor rocky soil. It is common on the sand barrens of New Jersey, and on exhausted farm land and cut-over areas.

IMPORTANCE OF THE SPECIES—It is not of much importance as a timber tree on account of its small size. While it is of little commercial importance still it is of considerable economic value as a reforester of worn-out and neglected lands. For ornamental purposes it has been used very little, other species being preferred.

SCOTCH PINE.

Pinus sylvestris, Linnaeus.

FORM—Usually 70 ft. high with a diameter of 1½-3 ft. but may attain a height of 120 ft. with a diameter of 3-5 ft. In the United States it is usually planted in the open and consequently it has a short, clean, often branched trunk bearing numerous, more or less drooping lateral branches. Trees in closed stands produce straight and clean trunks with little taper and a short compact crown. At a distance it resembles the Pitch Pine.

BARK—On the trunk scaly and peels off in flakes from the ridges which are separated by long shallow fissures. Lower part of the trunk is rough while the upper is rather smooth and distinctly reddish in color. Outside bark on the lower trunk is grayish-brown while the inner is reddish-brown.

TWIGS—Fairly stout, brittle, dark yellowish-gray, smooth, not glossy.

BUDS—Ovate, blunt-pointed, brown, often somewhat resinous.

LEAVES—In sheathed clusters of 2, 1½-3½ inches long, bluish-green, or dark green, stout, twisted, semi-circular in cross-section and containing 2 fibro-vascular bundles.

FLOWERS—Appear in April or May. Staminate flowers clustered on the lower half of this season's growth, ovate, scarcely 2/5 of an inch long. Pistillate flowers appear singly or in 2s just below the terminal buds of this season's growth, are ovoid and short-stalked.

FRUIT—A cone 1½-2½ inches long, short-stalked, conic-oblong, solitary or in 2s usually pointing backward and grayish or reddish in color.

WOOD—Non-porous; resinous, light, reddish-brown with thick light yellowish or reddish sapwood. Used for general construction, lumber, railroad ties, hop-poles, grape vine poles and fuel.

DISTINGUISHING CHARACTERISTICS—The Scotch Pine, a native of Europe, may be distinguished from the other Pines of Pennsylvania by the reddish appearance of the upper part of the trunk and adjoining branches, the bluish-green leaves 1½-3½ inches long, and the backward-pointing cones. It has rougher twigs than the Jersey or Scrub Pine, shorter needles than the Red Pine, stouter needles than the Yellow Pine, and blunter-pointed needles than the Table Mountain Pine.

RANGE—Not native to America. Abroad it extends over the greater part of Europe and part of western Asia. In the United States it can be planted over a large area in the northeastern states, the lake states, and some of the prairie states. Planted for ornamental purposes in many parts of this State and by the Pennsylvania Department of Forestry in numerous plantations.

HABITAT—This species is indifferent to soil requirements, water, heat of summer, and cold of winter. It will grow on all classes of soil, even dry, sterile sand. The rate of growth depends more on the physical structure than the chemical composition of the soil. It prefers deep well drained sandy loam. It is very intolerant of shade.

IMPORTANCE OF THE SPECIES—The Scotch Pine is a very important tree in its native and adopted European home. It plays a prominent role in the forest structure of parts of Germany, such as the sandy plains along the Rhine and the large sandy areas of northern and eastern Prussia. Excellent forests of this species can be seen in Germany, but it is not necessary to introduce it into the United States extensively for forestry purposes since we have superior native species. It grows very rapidly in youth, but later more slowly.

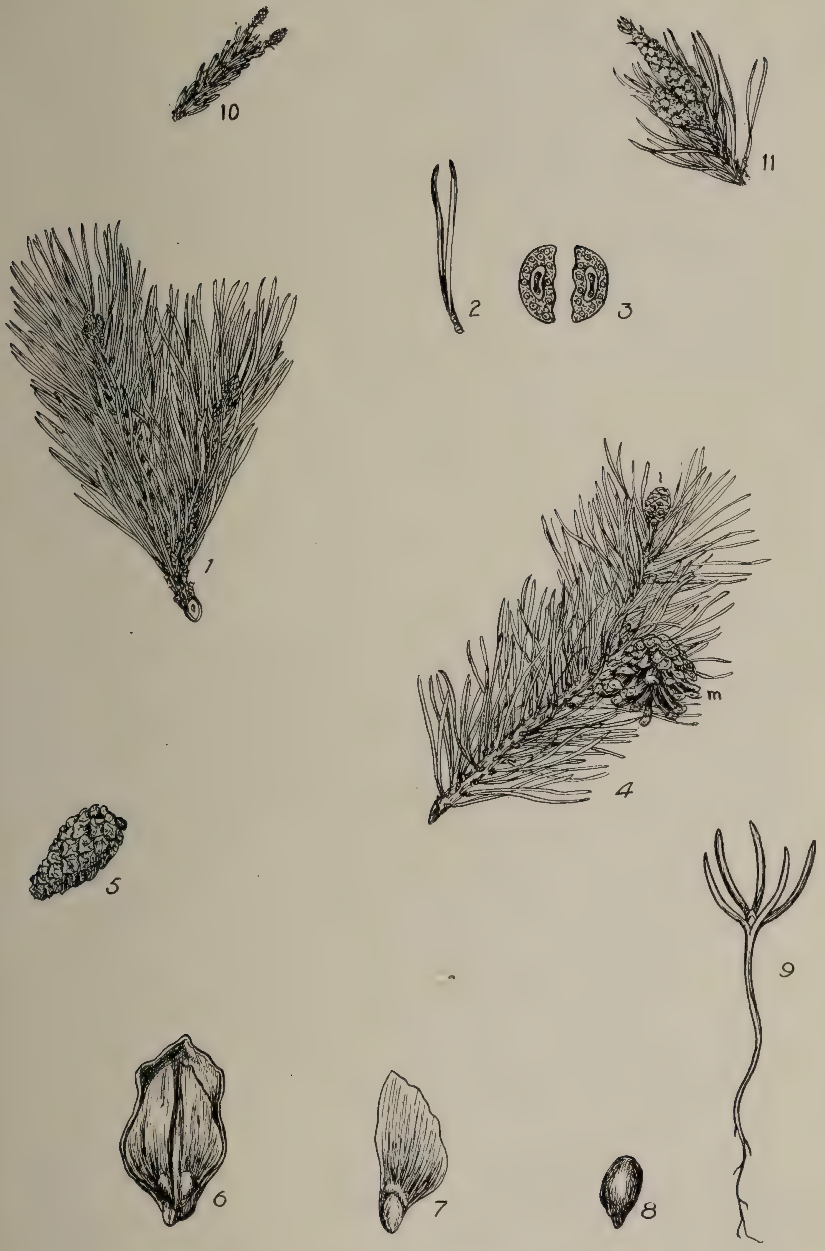

PLATE XVIII. SCOTCH PINE.

1. A branch with needles and buds, x ⅓.
2. A cluster of two needles, x ⅓.
3. Cross-section of two needles, enlarged.
4. Branch with needles; i, immature cone; m, mature cone, x ⅓.
5. A closed cone, x ⅓.
6. A cone scale with two winged seeds, enlarged.
7. A winged seed, enlarged.
8. A seed, enlarged.
9. A seedling, natural size.
10. A small portion of a branch with two pistillate flowers, x ⅓.
11. A branch with a cluster of staminate flowers at the base of the new growth, x ⅓.

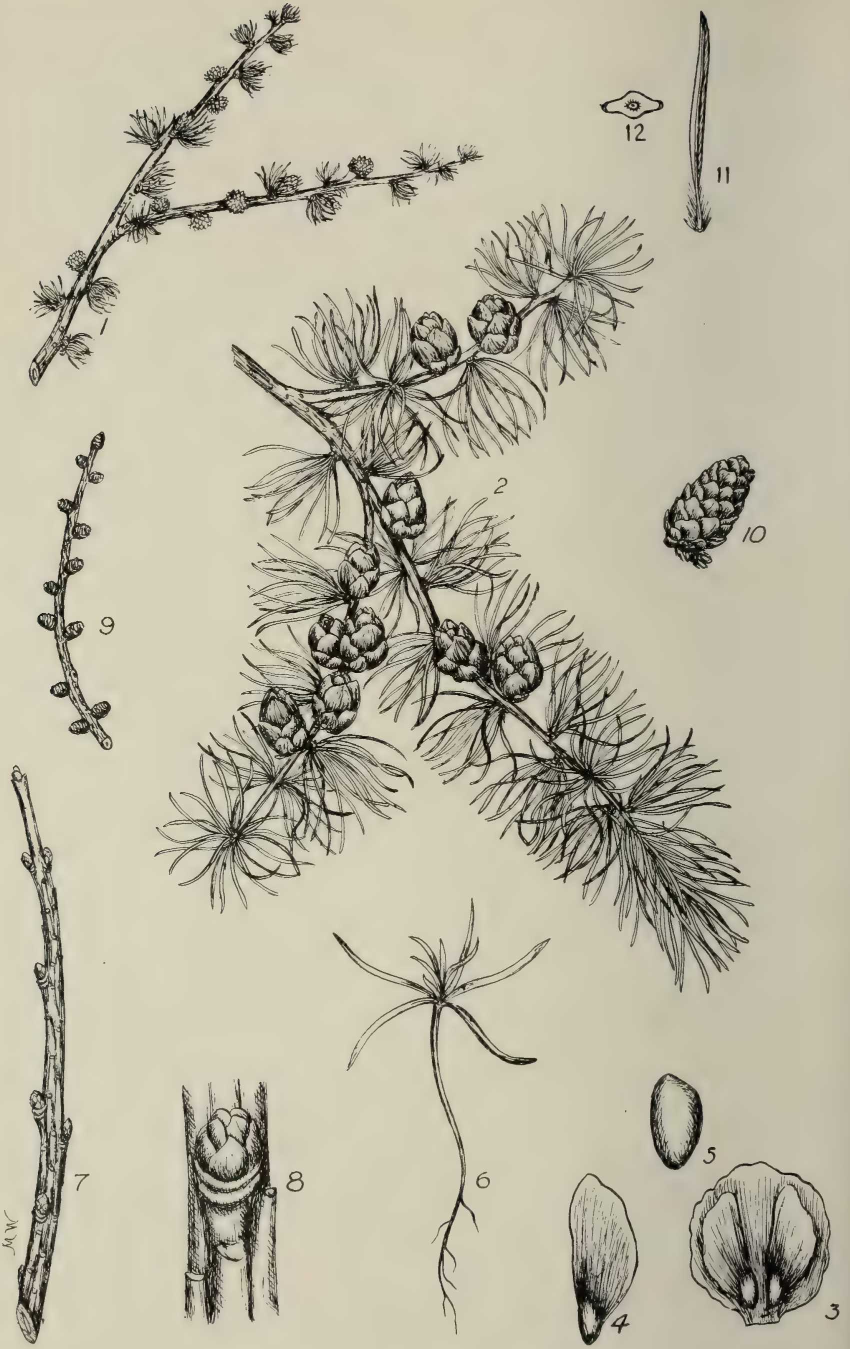

PLATE XIX. AMERICAN LARCH.

1. Branch with developing leaves and flowers, x ½.
2. Branch with needles (clustered and solitary) and fruit, x ½.
3. A cone scale with two winged seeds, enlarged.
4. A winged seed, enlarged.
5. A seed, enlarged.
6. A seedling, enlarged.
7. Terminal portion of a winter branch, natural size.
8. Section of a winter branch, enlarged.
9. A winter branch with lateral spurs, x ½.
10. A cone of European Larch (Larix decidua), x ½.
11. Leaf of European Larch, x ½.
12. Cross-section of leaf of European Larch, enlarged.

AMERICAN LARCH.

Larix laricina, (Du Roi) Koch.

GENUS DESCRIPTION—This genus comprises about 10 species found in the cooler portion of the northern hemisphere and occasionally extends beyond the Arctic Circle. Of the 10 known species 3 are found in North America, 2 in the western part and 1, a transcontinental species. The latter is found in Pennsylvania. The Larches all shed their leaves every fall and the following spring put out new ones. This deciduous habit gives the trees an appearance in winter of dead conifers. A single foreign species known as the European Larch (Larix decidua Mill.), is planted extensively for ornamental purposes and lately to a limited extent for forestry purposes. It is a very rapid grower and will thrive on drier and less fertile soil than our native eastern species. It should not be planted pure but mixed with other species.

FORM—A medium-sized tree usually attaining a height of 30-60 ft. with a diameter of 1-2½ ft., but many reach a height of 110 ft. with a diameter of 3 ft. Shrubby towards the northern limits of its range. Trunk straight, continuous, and bearing rather straight, slender, and slightly ascending branches which form in the open a narrow pyramidal crown.

BARK—On main trunk rather close but roughened by small, thin, roundish, reddish-brown scales. On the smaller branches it is smooth, thin, bluish-gray. See Fig. 49.

TWIGS—At first covered with a bloom, slender, smooth, later becoming dull brown, covered with numerous, short, stout, spur-like lateral branches.

BUDS—Occur at end of spur-like lateral branches and along last season's growth; small, about 2/5 of an inch long, globose, smooth, shining, and dark red in color.

LEAVES—Linear, triangular in cross-section, ¾-1¼ inches long, rounded above, keeled below, and deciduous. They occur either singly along terminal shoots or clustered in fascicles on short spur-like lateral branches.

LEAF-SCARS—Distinctly decurrent, very small, triangular in outline, and contain a single bundle-scar.

FLOWERS—Appear about May with the leaves. Staminate flowers sessile, sub-globose, yellow, and borne on one or two year old branches. Pistillate flowers short-stalked, oblong, reddish, and borne on lateral branches of previous year.

FRUIT—A cone, ovoid, light brown with blunt apex, ½-¾ of an inch long, consisting of about 20 scales which are largest near the middle and smaller towards the base and apex. Seeds winged, about ⅛ of an inch long and mature in one year.

WOOD—Non-porous; somewhat resinous, very heavy, hard, strong, very durable in contact with the soil; heartwood bright red; sapwood narrow and white. Weighs 38.86 lbs. per cubic foot. Used for fence posts, telegraph poles, railroad ties, and in ship building.

DISTINGUISHING CHARACTERISTICS—The American Larch, also known as Tamarack, Hackmatack, and Black Larch, is the only native deciduous conifer of Pennsylvania. In winter it is without leaves and presents the appearance of a dead tree. The leading branches with their spur-like lateral branches bearing tufts of linear leaves in summer and small reddish buds in winter, are charactertistic. It bears little resemblance to any of our native conifers but does resemble the European Larch (Larix decidua Mill.) which may be distinguished by its larger cones, stouter and yellower twigs, and longer and more abundant leaves.

RANGE—Newfoundland south to Pennsylvania, west to Minnesota and the Rocky Mountains, through British Columbia to Alaska. It is one of our few transcontinental species.

DISTRIBUTION IN PENNSYLVANIA—Found locally in moist locations in Carbon, Centre, Clinton, Crawford, Lackawanna, Lycoming, Monroe, Pike, Potter, Tioga and Warren counties.

HABITAT—Frequents swamps, banks of lakes and rivers, but also thrives on well drained hillsides. It is one of the most boreal of eastern conifers, extending north beyond the Arctic Circle to the limit of tree growth. On account of its wide range it experiences great diversity in climate. Each varied habitat seems to stamp the tree with some peculiarity which is evident in its form and structure. It requires abundant light throughout life.

IMPORTANCE OF THE SPECIES—The American Larch is essentially a northern tree but grows naturally in parts of Pennsylvania and may be grown artificially in other parts. The tree is especially adapted for wet locations and hence may be used where other more valuable species will not grow. Seedlings can be grown in the nursery and transplanted with success, but they should not be planted in dry locations. It has a very destructive enemy in a saw fly, which has recently destroyed a large number of trees over an extensive territory in the northeast.

THE SPRUCES—PICEA, Link.

The Spruces are evergreen trees with stiff, often sharp-pointed needles which persist for 7-10 years. All the species of Spruce found in eastern North America and all but two species found in western North America have four-sided needles. The two exceptions have flattened needles and bear stomata, commonly known as breathing pores, only on the upper surface, while the species with four-sided needles have stomata on all sides. The needles are spirally arranged on the branches and are not stalked but borne on decurrent projections of the bark known as *sterigmata.* The staminate and pistillate flowers are separate on the same tree, usually on the same branch. The staminate, which bear the pollen, are yellow to red in color, cylindrical in outline, and open lengthwise. The pistillate, which develop into cones, are erect, cylindrical, short-stalked, and pale yellow to scarlet in color. The cones mature at the end of one season and are always drooping and usually cylindrical to ovate in outline. The cones usually fall entire during the first winter or sometimes persist for a few years. They consist of numerous persistent cone-scales which are thin and unarmed, and consequently stand in strong contrast with the thick, usually armed, cone-scales of the Pines. The cone-scales are largest near the center and decrease in size towards the apex and the base. The fertile scales bear two winged seeds on each cone-scale. The seeds are usually light and bear a rather large wing, by means of which they are disseminated over great distances by the wind.

The trunks of the Spruces are straight, continuous, and taper gradually to the top. The lumbermen for a long time looked unfavorably upon the Spruces but owing to changed economic conditions and a more thorough knowledge of their technical value, these same species are now considered among our most important commercial species. The wood of these same species is now considered amongst the most important of the northern hemisphere and especially adapted for the manufacture of paper pulp. The spruce forests of North America for a long time remained practically untouched, but are now being exploited on a gigantic scale. The march of forest destruction is very rapid since an enormous supply is required for the paper pulp industry. In order to supply this growing demand and not diminish the available supply of spruce wood it is necessary that proper and systematic treatment be given to the existing spruce areas, since we cannot hope to import a supply sufficient to satisfy our demand.

This genus comprises about 18 to 20 known species, of which number 8 are found in North America, 3 in the eastern part and 5 in the western part. Two of the eastern species are native to Pennsylvania. In addition to the native species 2 species, exotic to the State, are commonly planted for ornamental purposes, viz., the Norway Spruce (Picea Abies (L.) Karst.), and Colorado Blue Spruce (Picea pungens Engelm.). The subjoined key will distinguish the Spruces commonly found in Pennsylvania.

KEY TO THE SPECIES.

Page.

1. Cones cylindrical, over 3 inches long; terminal part of lateral branchlets pendulous; leaves slender, dark green, glossy, sharp-pointed, ... **P. Abies** 82

1. Cones ovate to oblong, less than 3 inches long; terminal part of lateral branchlets not decidedly pendulous; leaves rather stout, often blunt-pointed, ...2

2. Leaves dark yellowish-green; cones elongated-ovoid with clear brown, entire-margined scales, ...**P. rubra** 80

2. Leaves bluish-green; cones short-ovoid; often persisting beyond first season; cone-scales dull, grayish-brown with jagged margin, ...**P. mariana** 81

RED SPRUCE.

Picea rubra, (Du Roi) Dietrich.

FORM—A medium-sized tree usually reaching a height of 70-80 ft. with a diameter of 1½-2 ft., but may attain a height of 110 ft. with a diameter of 3 ft. Trunk straight, continuous, slightly tapering, bearing long persisting lateral branches which are horizontal in the middle, ascending above and drooping below. Crown narrow, conical in form.

BARK—Up to ½ of an inch in thickness and roughened by irregular, thin, close, reddish-brown scales.

TWIGS—Rough, slender, light brown to dark brown, covered with pale to black hairs.

BUDS—Ovoid, sharp-pointed, ¼-⅓ of an inch long, covered by overlapping sharp-pointed reddish-brown scales.

LEAVES—About ½-⅝ of an inch long, 1/16 of an inch wide, 4-sided, yellowish-green, rounded at apex, crowded, and pointing outward in all directions on twig, without real leaf-stalks but raised on decurrent projections of bark, known as sterigmata.

LEAF-SCARS—Small, with a single bundle-scar, borne on decurrent projections of bark.

FLOWERS—Appear in April or May. Staminate and pistillate flowers separate, but appear on the same tree. Staminate oval, almost sessile, reddish in color. Pistillate cylindrical, ¾ of an inch long, and consist of rounded thin scales.

FRUIT—A cone about 1¼-2 inches long, elongated-ovoid, short-stalked, maturing at the end of first season; cone-scales rounded, reddish-brown, with entire margin.

WOOD—Non-porous; light, soft, not strong, pale in color, tinged with red, with resin passages present. Weighs 28.13 lbs. per cubic foot. Used in the manufacture of paper pulp, sounding boards for musical instruments, and construction.

DISTINGUISHING CHARACTERISTICS—The Red Spruce, sometimes known as the Spruce Pine, can be distinguished from the Black Spruce by its larger cones, which usually fall during the first winter, while those of the latter usually persist for a longer time. The cone-scales of the Red Spruce are a clear brown and entire-margined, while those of the Black Spruce are grayish-brown and more jagged. The needles of the Red Spruce are dark green to yellowish-green, while those of the Black Spruce are bluish-green. It can readily be distinguished from the White Spruce and the Colorado Blue Spruce by its hairy twigs, and from the Norway Spruce by its much smaller cones and absence of long pendulous branchlets.

RANGE—Newfoundland to Pennsylvania and south along the Alleghanies to Georgia, west to Minnesota. Heavy stands occur upon the high mountains of western North Carolina.

DISTRIBUTION IN PENNSYLVANIA—Frequents the swamps of Monroe, Pike and a few other counties.

HABITAT—Common upon mountain slopes and well drained upland, but also found on mountain tops and on the margin of swamps and streams.

IMPORTANCE OF THE SPECIES—The Red Spruce is one of the most important species which supply the wood used in the manufacture of paper pulp. Where natural regeneration is possible this species deserves to be developed, especially in places too wet for other species to grow. In this State, the Bear Meadows in Centre county and the lake regions of Pike and Monroe counties, with their adjoining swamps, give excellent conditions for the natural development of this species.

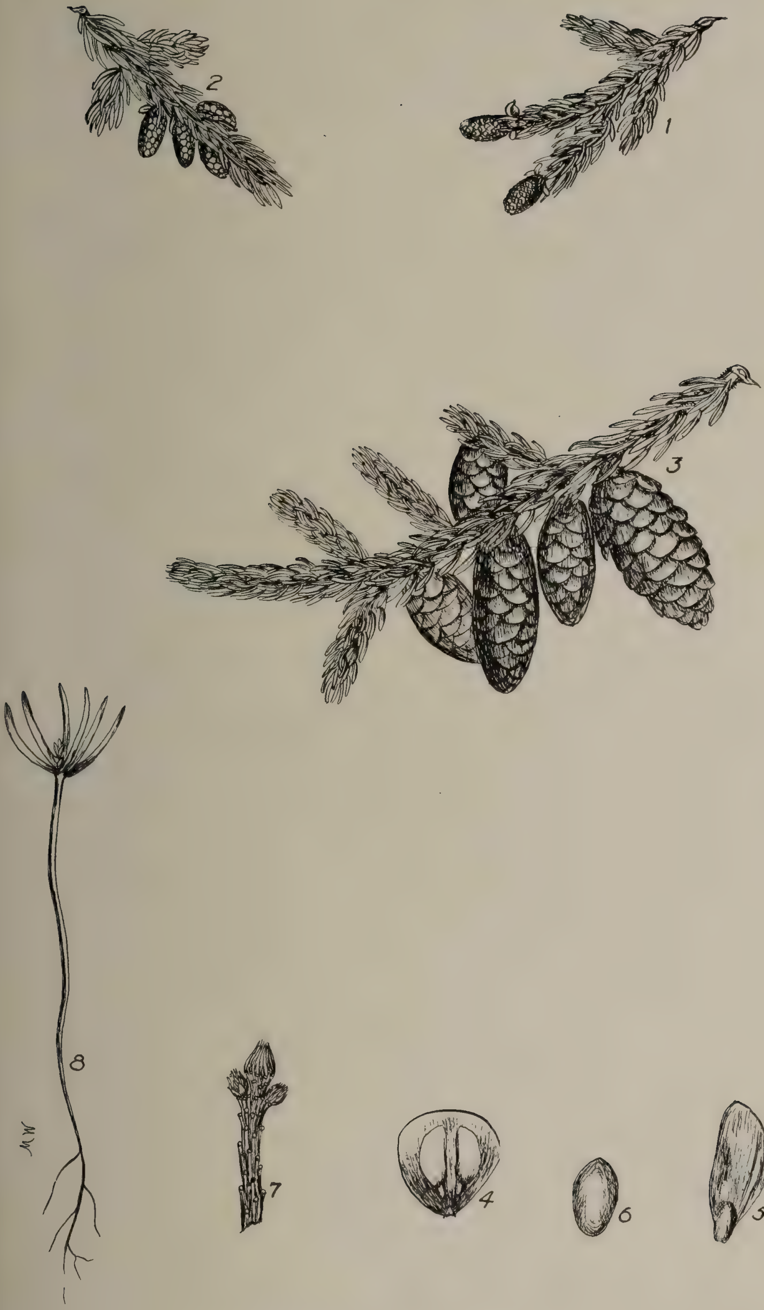

PLATE XX. RED SPRUCE.

1. Branch with pistillate flowers, x ½.
2. Branch with staminate flowers, x ½.
3. Branch with needles and cones, x ½.
4. A cone scale with two winged seeds, x ½.
5. A winged seed, natural size.
6. A seed, enlarged.
7. Terminal portion of a twig with buds and without needles, natural size.
8. A seedling, natural size.

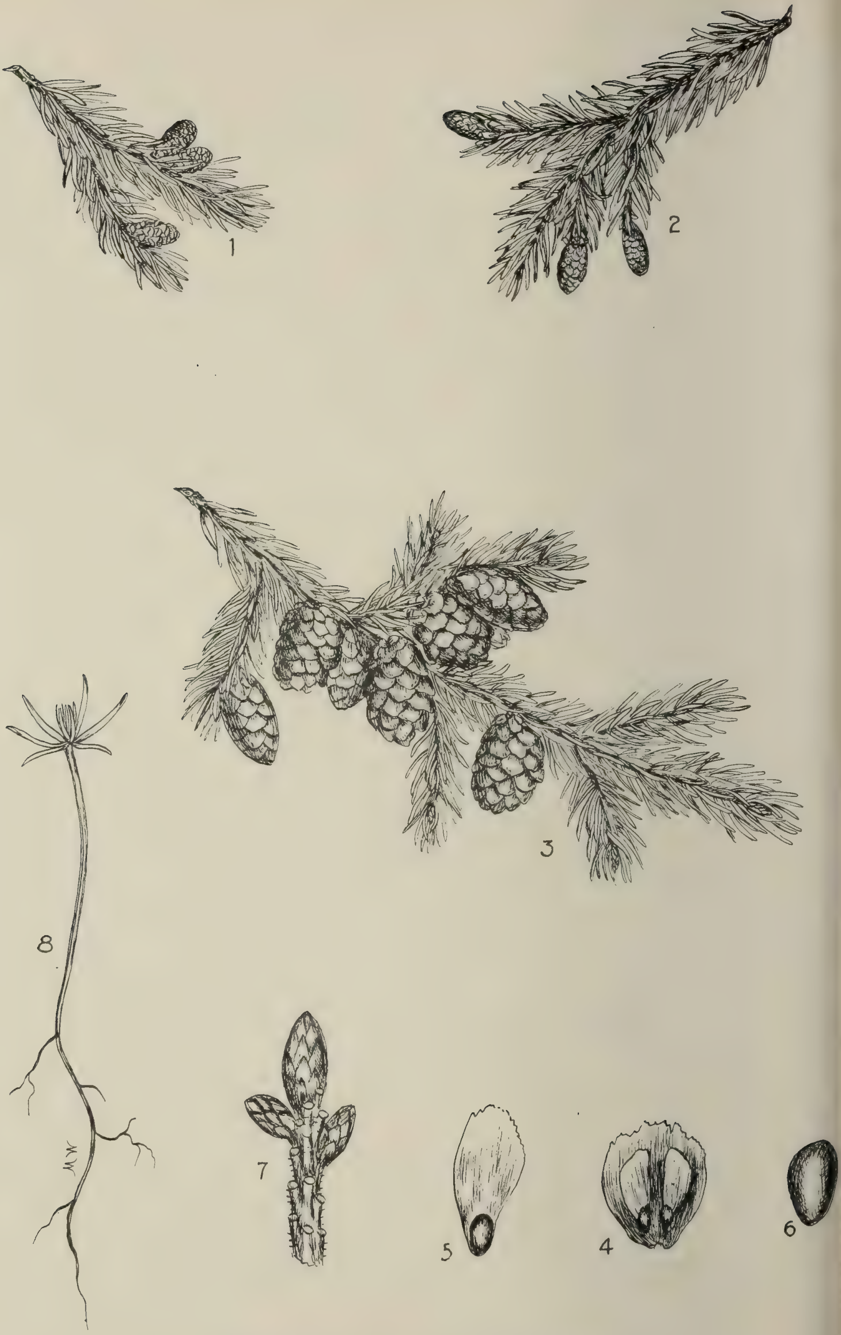

PLATE XXI. BLACK SPRUCE.

1. Branch with pistillate flowers, x ½.
2. Branch with staminate flowers, x ½.
3. Branch with needles and cones, x ½.
4. A cone-scale with two winged seeds, x ½.
5. A winged seed, natural size.
6. A seed, enlarged.
7. Terminal portion of a twig with buds and without needles, enlarged.
8. A seedling, natural size.

BLACK SPRUCE.

Picea mariana, (Miller) BSP.

FORM—A small tree usually attaining a height of 20-30 ft. with a diameter of 1 ft., but may reach a height of 100 ft. with a diameter of 3 ft. Trunk straight, continuous, very tapering, bearing irregular, rather short, horizontal branches, often with ascending tips which give the tree a very narrow, irregular, conic form.

BARK—Up to ½ of an inch in thickness and roughened by irregular, thin, close, grayish-brown scales. See Fig. 51.

TWIGS—Rough, stout, brown to yellowish-brown, covered with pale to black hairs.

BUDS—Ovoid, sharp-pointed, ¼-⅓ of an inch long, covered with overlapping, sharp-pointed, reddish-brown scales.

LEAVES—About ¼-¾ of an inch long, 4-sided, bluish-green, rounded at apex, straight or slightly curved, without real leaf-bases, but resting on decurrent projections of bark known as sterigmata.

LEAF-SCARS—See "Leaf-Scars" under Red Spruce.

FLOWERS—Appear about May. Staminate and pistillate flowers occur on same plant but often on different parts of it. Staminate sub-globose, almost sessile, ½ of an inch long, reddish in color. Pistillate oblong, cylindrical, ⅛ of an inch long.

FRUIT—A cone about 1½ inches long, short-ovoid, short-stalked, maturing at the end of the first season; cone-scales rounded, dull grayish-brown with jagged margin.

WOOD—Non-porous; with resin passages present; light, soft, not strong, pale yellowish-white in color. Weighs 32.86 lbs. per cubic foot. Used in the manufacture of paper pulp and occasionally in lumber.

DISTINGUISHING CHARACTERISTICS—See "Distinguishing Characteristics" under Red Spruce page 80.

RANGE—It is a transcontinental species extending from Labrador to Alaska and south to Pennsylvania and Wisconsin.

DISTRIBUTION IN PENNSYLVANIA—Frequents swamps, rather common along lakes and in swamps of Monroe and Pike counties and in Bear Meadows, Centre and Huntingdon counties. Also reported in Cambria, Clinton, Lackawanna, Lycoming and Mifflin counties.

HABITAT—The Black Spruce, also known as Swamp Spruce, usually frequents cold, poorly drained swamps throughout its range. It sometimes ascends well drained hillsides, but is usually stunted in such situations. It makes its best growth on moist alluvial soils and is very tolerant of shade.

IMPORTANCE OF THE SPECIES—The Black Spruce is of little commercial importance in Pennsylvania and should be considered for forestry purposes in extremely swampy locations only, where other more valuable species will not grow. It cannot be recommended for ornamental planting since other species of Spruce far surpass it for this purpose.

NORWAY SPRUCE.

Picea Abies, (Linnaeus) Karsten.

FORM—A large tree usually attaining a height of 50-80 ft. with a diameter of 2 ft., but may reach a height of 125 ft. with a diameter of 3 ft. Trunk straight, continuous, slightly tapering, and sometimes free from lateral branches for a considerable distance from the base. Crown less acutely pyramidal than that of our native species.

BARK—On old trunks roughened with large, rather thick reddish-brown scales; on younger trunks the scales are thinner and closer. Used in tanneries in Europe, but only slightly charged with tannin.

TWIGS—Slender, rather pendulous, light reddish-brown and roughened by projecting leaf-bases.

BUDS—Ovate to conical, smooth, pointed, covered by overlapping, sharp-pointed, light brown scales.

LEAVES—About ½-1 inch long, sharp-pointed, 4-sided, dark green, without real leaf-stalks, but resting on decurrent projections of bark known as sterigmata.

LEAF-SCARS—See "Leaf-Scars" under Red Spruce.

FLOWERS—Appear about May when pollination takes place. Fertilization takes place in June.

FRUIT—A cone about 4-7 inches long, cylindrical-oblong, pendant, almost sessile, maturing at the end of the first season; cone-scales thin, stiff, rather broad reddish-brown with finely toothed margin.

WOOD—Non-porous; resin passages present; straight-grained, strong, not durable in contact with the soil, medium in hardness, works easily, heartwood yellowish-white with thin white sapwood. Weighs 30 lbs. per cubic foot. Used in the manufacture of paper pulp, general construction, interior finish, basket making and for masts and oars on small vessels.

DISTINGUISHING CHARACTERISTICS—The Norway Spruce, also known as the European Spruce, can readily be distinguished by its large cones, which are from 4-7 inches long, and by the long, pendulous branchlets terminating the lateral branches. The sharp-pointed, bluish-green, 4-sided needles will also aid in distinguishing it from some of the other closely related species.

RANGE—Its native home is in middle and northern Europe. It forms a very important part of the forest structure of Germany, Switzerland, Austria and Russia. Planted extensively in the United States for ornamental purposes from Maine south to Washington and west to Kansas.

DISTRIBUTION IN PENNSYLVANIA—It is found throughout the State as an ornamental tree, and planted rather extensively for forestry purposes by the State Department of Forestry.

HABITAT—In Europe it grows in valleys and upon the mountain slopes. It prefers rather rich moist soils, in this respect somewhat resembling the White Pine. It cannot endure very dry, very sterile, or extremely rich vegetable soil. It is rather tolerant of shade and somewhat susceptible to late frosts.

IMPORTANCE OF THE SPECIES—The Norway Spruce is a foreigner in our forest flora, but before long it will be regarded a naturalized member of our forest structure. It will be an extremely valuable addition to the list of species of forestal significance. To the present time it has been planted mostly for ornamental purposes and for wind breaks, but in the future it will also be planted extensively as a forest tree. It grows rapidly and is rather hardy and free from organic enemies and produces valuable wood. A noted European authority on forestry has said: "Spruce is the best paying forest species in the world." It should be planted as a seedling and preferably mixed with such species as White Pine, European Larch, Douglas Fir, Red Oak, White Ash, and Tulip Tree. It is also possible that it could be grown at a profit for Christmas tree purposes.

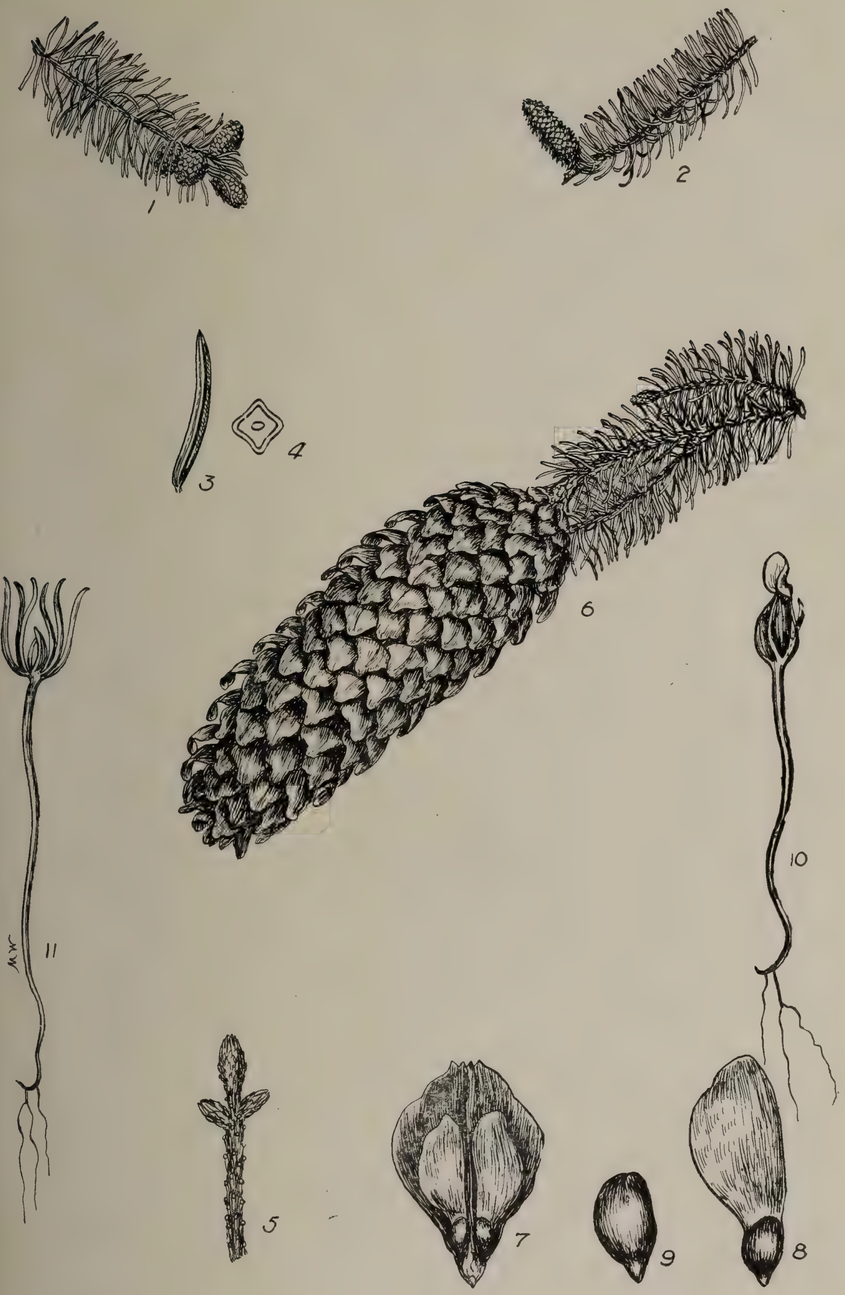

PLATE XXII. NORWAY SPRUCE.

1. Branch with staminate flowers, x ½.
2. Branch with pistillate flowers, x ½.
3. A needle, natural size.
4. Cross section of a needle, enlarged.
5. Branch with needles removed showing winter buds, x ¾.
6. Branch with needles and a cone, x ½.
7. A cone scale with two winged seeds, natural size.
8. A winged seed, enlarged.
9. A seed, enlarged.
10. A seedling shedding a seed coat, natural size.
11. A seedling, natural size.

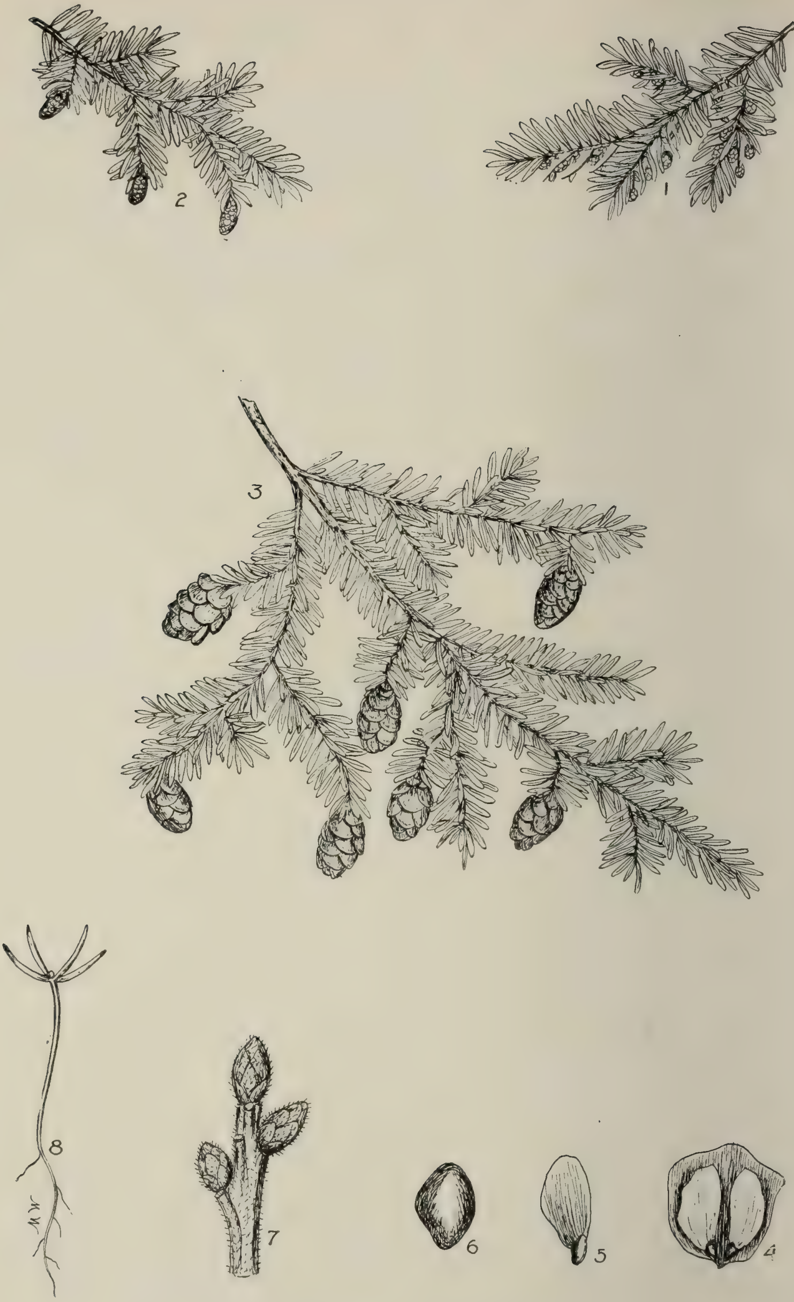

PLATE XXIII. HEMLOCK.

1. Branch with needles and staminate flowers, x ½.
2. Branch with needles and pistillate flowers, x ½.
3. Branch with needles and mature cones, x ½.
4. A cone scale with two winged seeds, natural size.
5. A winged seed, natural size.
6. A seed, enlarged.
7. Leafless branch with buds, enlarged.
8. A seedling, natural size.

HEMLOCK.

Tsuga canadensis, (Linnaeus) Carriere.

GENUS DESCRIPTION—This genus comprises 8 species in the world, 4 of which are native to North America and 1 to Pennsylvania. Of the 4 species native to North America, 2 are found in the eastern and 2 in the western part. The 2 eastern species are the Carolina Hemlock (Tsuga caroliniana Engelm.) found only in the mountains from Virginia to Georgia, and the species described below. The Hemlocks are trees of the northern hemisphere, found in North America and Asia, but absent in Europe. The eastern species in particular are slow growers and difficult to transplant. A well known student of forestry has said, "Hemlock trees are like the Indians, they will not stand civilization."

FORM—A large tree usually attaining a height of 60-80 ft. with a diameter of 2-3 ft., but may reach a height of 100 ft. with a diameter of 4 ft. In the open its crown is dense, conic, and high with limbs extending almost to the ground. In dense stands it has a bole, clean from lateral branches for a considerable distance from the ground and with little taper.

BARK—Grayish-brown to reddish-brown, rich in tannin, becoming 4/5 of an inch thick on old trunks and roughened by long fissures separating rather broad ridges which are covered with close scales. Innner bark is cinnamon-red. See Fig. 53.

TWIGS—Slender, rough on account of decurrent projections of bark upon which the leaves rest, at first somewhat hairy and yellowish-brown, later smooth grayish-brown tinged with purple.

BUDS—Alternate, ovate, 1/16 of an inch long, blunt-pointed, reddish-brown, not glossy.

LEAVES—Linear, flat, about ½ of an inch long, rounded or notched at apex, dark green and shining above, pale green and dull below with a white line on each side of midrib. The leaves persist for about 3 years and are jointed to short, persistent, woody stalks. They are somewhat spirally arranged around the twig but appear two-ranked.

LEAF-SCARS—Small, round, raised on decurrent projections of bark.

FLOWERS—Appear about April or May. Staminate and pistillate flowers separate, but usually borne on the same branch. Staminate small, globose, yellow, about ¼ of an inch long. Pistillate oblong and pale green.

FRUIT—A small, short-stalked cone maturing at the end of the first season, about ¾ of an inch long, usually persisting during first winter.

WOOD—Non-porous; without resin passages; light, hard, not strong, brittle, coarse-grained not durable, liable to splinter, difficult to work, light brown with lighter sapwood. Weighs 26.42 lbs. per cubic foot. Used for construction, coarse lumber, and especially for frame work and weather-boarding of buildings, paper pulp, and laths.

DISTINGUISHING CHARACTERISTICS—The Hemlock, also known as Hemlock Spruce and Spruce Pine, can be distinguished by its flat linear needles with two longitudinal white streaks on the lower surface; the needles are jointed to short persistent woody stalks known as sterigmata and appear two-ranked, but in addition to the two conspicuous lateral rows there is a rather inconspicuous row of small needles on top of the twig extending in the same direction as the twig. The lateral twigs occur rather irregularly along the main branches and diverge from the latter at an angle of usually less than 75°. The cones are about ¾ of an inch long, and often persist through one winter. The inner bark is cinnamon-red.

RANGE—Nova Scotia south to Pennsylvania and along the mountains to Alabama, and west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Rather commonly distributed in moist situations throughout the mountainous regions of the State. Most common in the central and northern parts. Scattered in local groups in the southeastern and southwestern parts.

HABITAT—Usually found in moist locations like northern slopes of rocky ridges, banks of streams, ponds and lakes, swamps, river gorges, and mountain slopes. It prefers a dense forest structure since it is shade loving and not very wind-firm.

IMPORTANCE OF THE SPECIES—This tree yields not only lumber but also bark rich in tannic acid and a volatile oil to which a medicinal value was attached. The inferior wood which it produces coupled with its slow growth and the difficulty with which it is established by planting will tend to decrease its prevalence in our forest structure, especially since more valuable and more rapid growing species like Pine and Spruce will thrive on the same area. Wherever it can be regenerated naturally without sacrificing more valuable species it should be retained in the forest structure. It is one of the most attractive if not the most attractive of our coniferous evergreens.

BALSAM FIR.

Abies balsamea, (Linnaeus) Miller.

GENUS DESCRIPTION—The Firs comprise about 25 species, of which number 10 species are native to North America and 1 to Pennsylvania. They are usually found in cold and temperate regions. Eight species are found in western North America, while only 2 species are native east of the foot hills of the Rocky Mountains, 1 of which is native to Pennsylvania. The other eastern species not native to Pennsylvania, Abies Fraseri (Pursh.) Poir, is found only in the Appalachian Mountains from Virginia to North Carolina and Tennessee.

FORM—A medium-sized tree attaining a height of 30-50 ft., but may reach a height of 100 ft. with a diameter of 3 ft. Usually a low spreading shrub in high altitudes and high latitudes. Crown slender, symmetrical when young, and sharp-pointed, deeper and often broader in older specimens.

BARK—On old trees reddish-brown and somewhat roughened by irregular scales. On young trees smooth, thin, close, grayish-brown, and marked by projecting resin blisters. See Fig. 50.

TWIGS—Slender, at first hairy and yellowish-green, later smooth, and grayish-brown, usually arranged opposite one another.

BUDS—Clustered at end of terminal twigs, ovate to spherical, about 1/6 of an inch long, covered with very glossy, varnished, orange-green scales.

LEAVES—Apparently 2-ranked as in the Hemlock, linear, flattened, ¾ of an inch long, usually blunt at apex, stalkless, dark green and shining above, pale with light dots below, very fragrant upon drying.

FLOWERS—Appear about May or June. Staminate and pistillate flowers separate but usually found on different parts of same branch. Staminate cylindrical, yellow, ¼ of an inch long. Pistillate oblong-cylindrical, purple, 1 inch long.

FRUIT—An erect, oblong-cylindrical, dark purple cone, 2-4 inches long, with broad round deciduous scales which fall off and leave the bare central axis. Cones mature at the end of first season. Seeds about ¼ of an inch long, winged, and borne on cone-scales.

WOOD—Non-porous; without resin passages; with no distinct heartwood, light, soft, pale brown, not strong nor durable. Weighs 23.80 lbs. per cubic foot. Used with Spruce for paper pulp, crates, packing boxes, and occassionally for lumber.

DISTINGUISHING CHARACTERISTICS—The Balsam Fir, also known as Fir, Balsam, and Blister Pine, is distinguished from the other native conifers of Pennsylvania by its smooth grayish-brown bark covered with projecting blisters, its oblong-cylindrical erect cones with deciduous scales, and by its rather flattened, apparently 2-ranked leaves which are stalkless and leave a circular flat scar upon falling. The leaves of the Balsam Fir somewhat resemble those of the Hemlock, but they are not jointed to a woody stalk while those of the latter species are jointed to short persistent stalks known as sterigmata.

RANGE—Labrador west to Alberta, south to Pennsylvania and Minnesota and along the mountains to Virginia.

DISTRIBUTION IN PENNSYLVANIA—Confined almost entirely to the swamps and lake regions of Centre, Pike, Monroe, Lycoming, Tioga, and Sullivan counties. It is also reported from a few other local outposts.

HABITAT—Usually inhabits swamps or their borders. In the north found commonly in low swampy bogs but in the south usually found on the mountain tops and slopes. Generally occurs in mixture but may occur locally in almost pure stands. Spruce and Hemlock are its common associates.

IMPORTANCE OF THE SPECIES—This tree is of little commercial importance in this State on account of its limited distribution and the small size which it attains. It is difficult to regenerate artificially since the seeds have a low germinating percentage, and the subsequent establishment is also difficult. This species should be regenerated naturally upon such areas where other more valuable species will not grow. The Balsam Fir is commonly used as a Christmas tree and it is possible that in the future it may pay to raise it for this purpose.

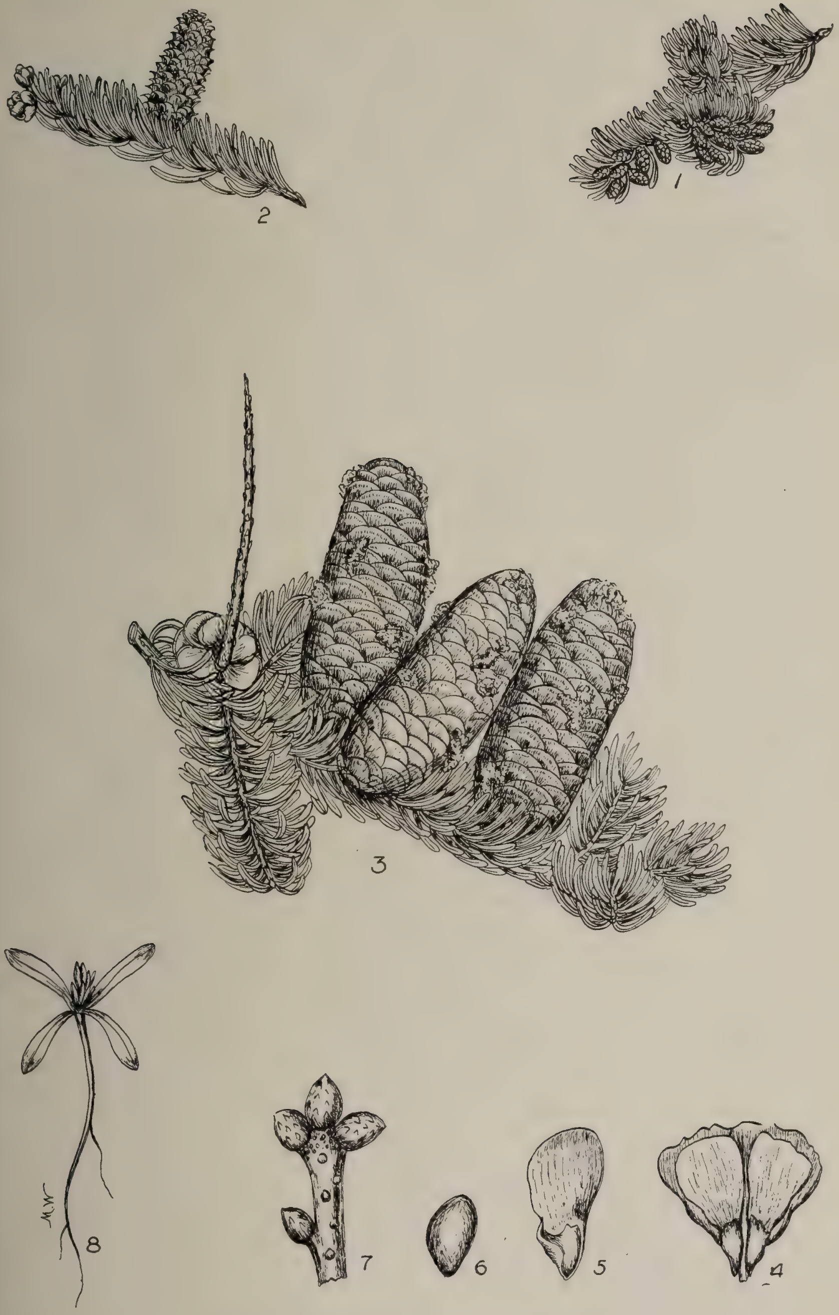

PLATE XXIV. BALSAM FIR.

1. Branch with needles and staminate flowers, x ½.
2. Branch with needles and pistillate flowers, x ½.
3. Branch with needles, three cones and one cone axis from which the scales have fallen, x ½.
4. A cone scale with two winged seeds, natural size.
5. A winged seed, slightly enlarged.
6. A seed, enlarged.
7. Leafless branch with buds, slightly enlarged.
8. A seedling, x ½.

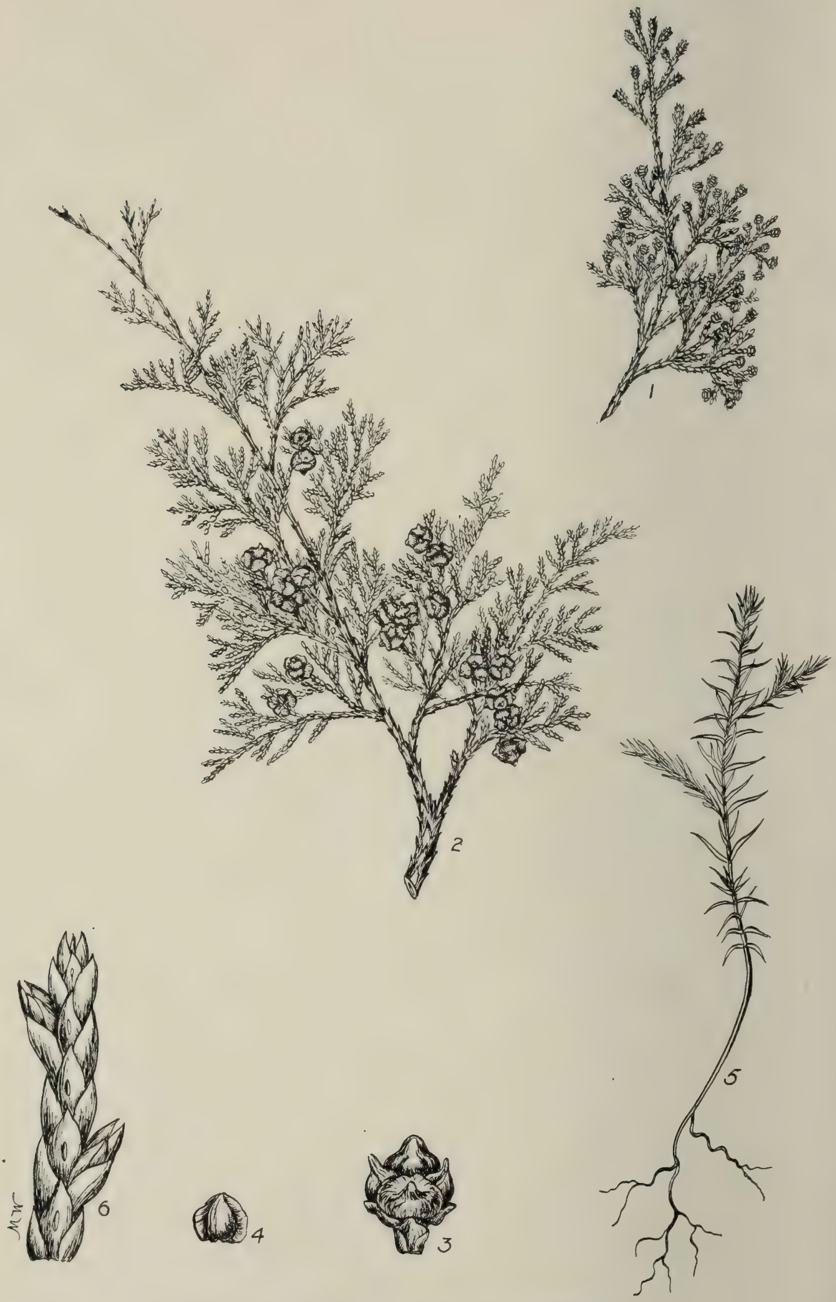

PLATE XXV. WHITE CEDAR.

1. A flowering branch, x ½.
2. A branch with needles and fruit, x ½.
3. A cone, slightly enlarged.
4. A winged seed, slightly enlarged.
5. A seedling, natural size.
6. Portion of branch, enlarged.

WHITE CEDAR.

Chamaecyparis thyoides, (Linnaeus) BSP.

GENUS DESCRIPTION—This genus comprises about 6 species in the world, of which number 3 are native to North America. Of the 3 species native to North America 2 are found in the western part, while only 1 is found in the eastern part. The latter is native to a small portion of Pennsylvania. The Cedars are not very well known as forest trees, but are planted extensively in this country and abroad for ornamental purposes. The lumberman is just beginning to appreciate the value of the wood which is obtained from the western species.

FORM—A small tree usually attaining a height of 30-50 ft. with a diameter of 1-2 ft., but may reach a height of 90 ft. with a diameter of 4 ft. Trunk straight, continuous, tapering, and bears slender horizontally spreading branches which form a narrow, pointed, conical crown.

BARK—Rather thin, reddish-brown, somewhat furrowed, peels off into long, fibrous, film-like scales.

TWIGS—Rather slender, somewhat flattened, at first bluish-green, later after the leaves have fallen they become roundish and reddish-brown. The terminal twigs are often arranged in fan-like clusters.

BUDS—Very small and inconspicuous, usually covered by the closely overlapping scale-like leaves.

LEAVES—Small, ovate, sharp-pointed, bluish-green, closely overlapping, scale-like, 4-ranked but presenting a compressed appearance. Often spreading and awl-shaped on vigorous shoots. A conspicuous but rather small glandular dot is often found on the back.

LEAF-SCARS—Not present because leaves persist for 4 or more years; then die and dry up upon the branches.

FLOWERS—Appear in March or April. Staminate flowers oblong, about ⅛ of an inch long, with 10-12 stamens on shield-shaped filaments. Pistillate flowers globular, about 1/10 of an inch in diameter, with about six shield-shaped scales each usually bearing 2 ovules.

FRUIT—A small globose cone which is rather common but inconspicuous, about ¼ of an inch in diameter and maturing at the end of the first season. Scales of cone shield-shaped and joined to axis of cone by stalk. Outer face of scale is marked by a slight projection. Each fertile scale bears 1 or 2 fertile winged seeds.

WOOD—Non-porous; light, soft, not strong, very durable, slightly fragrant, light brown tinged with red; sapwood pale. Weighs 20.70 lbs. per cubic foot. Used in cooperage and boat building, for fence posts, railroad ties, shingles, and woodenware.

DISTINGUISHING CHARACTERISTICS—The White Cedar, also known as Cedar and Coast White Cedar, can be distinguished by its characteristic globose fruit with shield-shaped scales which are fastened to the main axis by means of short stalks. It somewhat resembles the Arbor Vitae but the former has less flattened and less distinctly fan-shaped twigs. The twigs of the White Cedar are not so stout as those of the Arbor Vitae. The former also has bluish-green leaves while the latter has yellowish-green. It can be distinguished from the Red Cedar and the Common Juniper by its more prominent glandular dots on the leaves and its round twigs; the twigs of the latter species are 3 to 4-sided. It also lacks the awl-shaped leaves found on the Common Juniper and usually found on the Red Cedar.

RANGE—Cape Breton Island southward along coast region to Florida and Mississippi.

DISTRIBUTION IN PENNSYLVANIA—Native only to a few counties in the southeastern part of the State, but found as an ornamental tree in practically every part of the State.

HABITAT—Prefers swamps and marshes but will grow in dry locations. Occupies many swamps to the exclusion of other tree species. In the south it is often found in the swamps with the Bald Cypress and in the north with Arbor Vitae, Fir, and Spruce.

IMPORTANCE OF THE SPECIES—This species is so limited in its distribution in Pennsylvania and the wood of so little commercial importance that it cannot be recommended for forestry purposes. It may be recommended for very swampy locations where other more valuable species will not grow, and deserves to be planted extensively for ornamental purposes since it is one of the most beautiful coniferous trees of eastern North America on account of its attractive form and beautiful foliage. More than a dozen varieties of it are known.

ARBOR VITAE.

Thuja occidentalis, Linnaeus.

GENUS DESCRIPTION—This genus comprises 4 known species in the world, of which number 2 are found in North America. One of the 2 species native to North America is found in the eastern part, and the other in the western part. The species found in the western part attains a large size, while the one found in the eastern part usually remains a small tree. They are best known as ornamental trees but furnish some lumber, which is very valuable on account of its great durability. The bark also yields tanning material and the twigs and leaves contain a volatile oil which possesses stimulating properties.

FORM—A medium-sized tree usually attaining a height of 20-50 ft. with a diameter of 1-2 ft. but may reach a height of 75 ft. with a diameter of 3-4 ft.

TRUNK—Tapering, furrowed, buttressed and often divided. Crown dense, conical, very high, and often covered with foliage almost to the base.

BARK—Grayish to reddish-brown, thin, furrowed, separating into long rather thin, fibrous and often persistent strips.

TWIGS—Yellowish-green, evidently flattened, somewhat 4-sided, completely covered by closely adhering leaves, zig-zag or arranged in fan-shaped clusters.

BUDS—Leaf-buds not scaly, covered by closely adhering scale-like leaves.

LEAVES—Opposite, scale-like, closely overlapping, aromatic when crushed, with very conspicuous glandular spots on the thrifty shoots, ⅛ of an inch long, of two kinds in alternating pairs. Those on the side of the twigs keeled; those on the face of the twigs flat.

FLOWERS—Appear about April or May. Staminate and pistillate flowers usually occur on different twigs. Staminate roundish, inconspicuous and yellowish. Pistillate small, ovoid, purplish, with 4-6 pairs of thin oval scales.

FRUIT—An oblong cone with 6-12 obtuse scales, ⅓-½ of an inch long, reddish-brown, matures in one season. Seeds oblong, winged, about ⅛ of an inch long.

WOOD—Non-porous; resin passages absent; light, soft, durable, fragrant; sapwood almost white, heartwood yellowish-brown. Weighs 19.72 lbs. per cubic foot. Used for fence posts, rails, shingles, spools, and railroad ties.

DISTINGUISHING CHARACTERISTICS—The Arbor Vitae, also known as White Cedar and Cedar, may be distinguished at any season of the year by its scale-like and closely overlapping leaves from all the other trees native to the State of Pennsylvania except the White Cedar. It can be distinguished from the latter, which also has scale-like leaves, by its more flattened and larger twigs, which are also more fan-shaped. The fruit of the Arbor Vitae is oblong with thin oblong scales, while that of the White Cedar is spherical with thick shield-shaped scales.

RANGE—Southern Labrador west to Manitoba and Minnesota, and south along the mountains to North Carolina and eastern Tennessee.

DISTRIBUTION IN PENNSYLVANIA—The Arbor Vitae is found to the north and south of Pennsylvania, but so far no authentic records are available which show that it is native to this State. It is, however, found very commonly throughout the entire State as an ornamental tree and sometimes as a hedge.

HABITAT—Usually found in low swampy situations on the borders of ponds, streams, and lakes, but occassionally ascends to drier ground. In the north it is often found in the sphagnum bogs with Spruce and Fir, while in the south it is usually found on the mountain slopes and tops with the Spruce and other coniferous species.

IMPORTANCE OF THE SPECIES—The Arbor Vitae is one of our most valuable species for ornamental purposes. It is common throughout the State as an ornamental tree and occasionally planted for hedges. As a timber tree, however, it is surpassed by many other native species and should be planted for forestry purposes only in such habitats where other more valuable species will not grow.

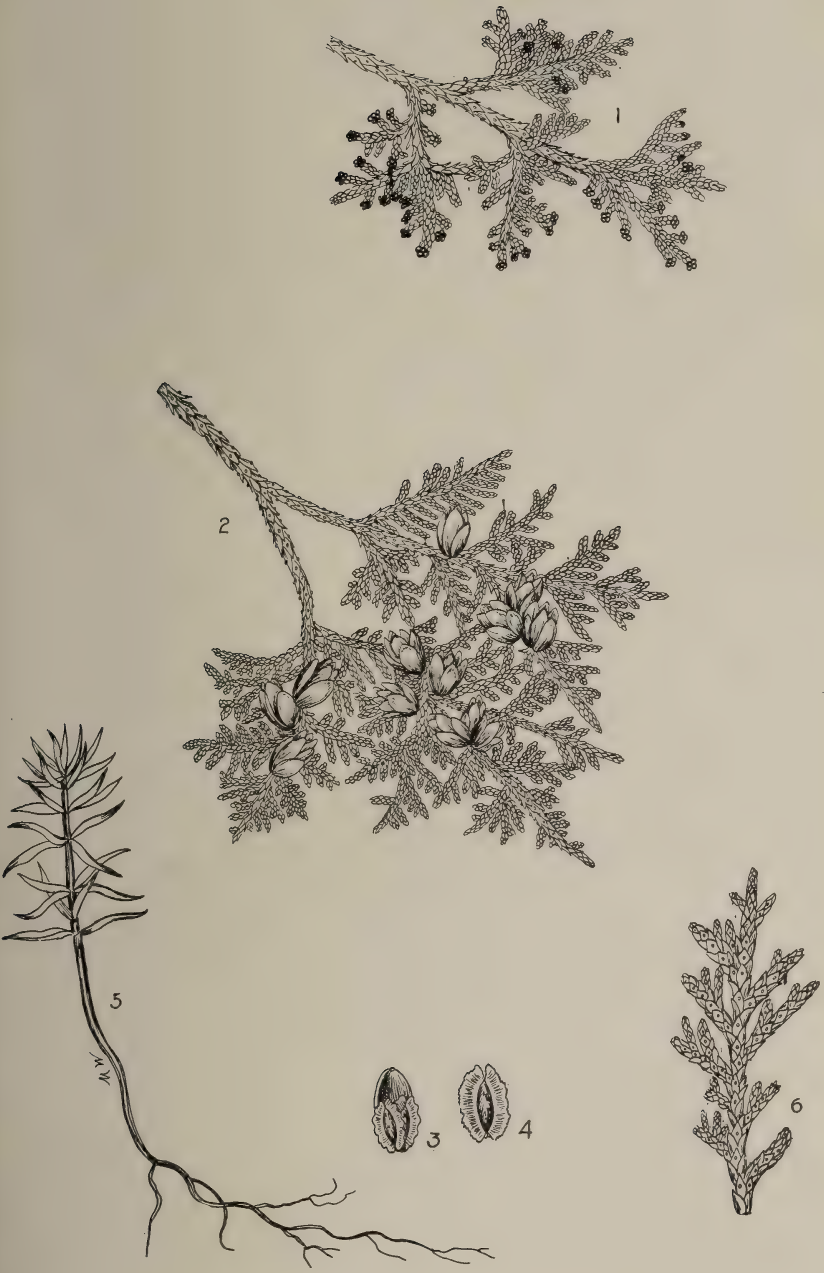

PLATE XXVI. ARBOR VITAE.

1. A flowering branch, x ½.
2. A branch with needles and fruit, x ½.
3. A cone-scale with winged seeds, natural size.
4. A winged seed, enlarged.
5. A seedling, natural size.
6. Portion of branch, natural size.

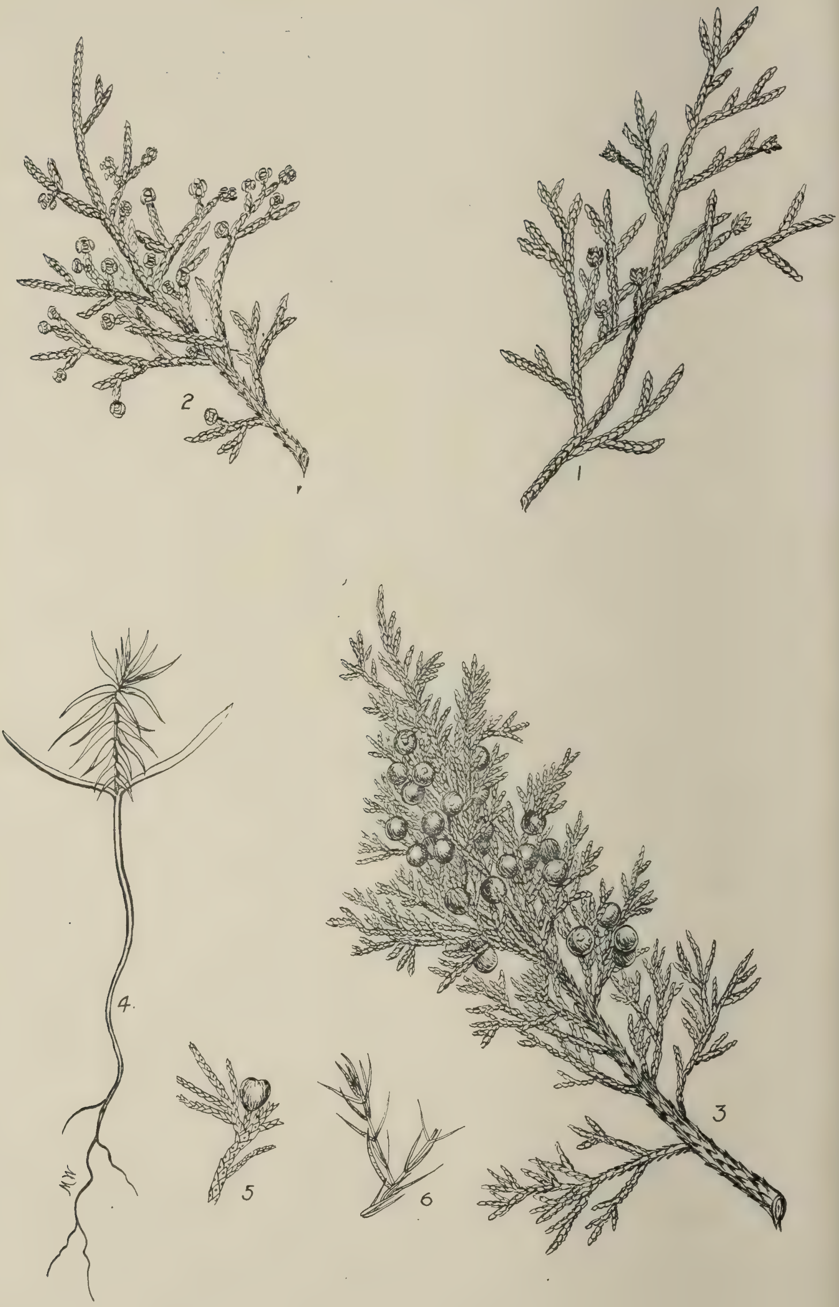

PLATE XXVII. RED CEDAR.

1. A branch with pistillate flowers, x ½.
2. A branch with staminate flowers, x ½.
3. A branch with needles and fruit, x ½.
4. A seedling, natural size.
5. A branch with scale-like needles and a single berry-like fruit, natural size.
6. A branch with awl-shaped needles, x ½.

RED CEDAR.

Juniperus virginiana, Linnaeus.

GENUS DESCRIPTION—This genus comprises about 40 species of trees and shrubs in the world, of which number 16 species are native to North America and 2 to Pennsylvania. The Junipers are usually medium-sized trees or occasionally shrubs. This is possibly the most widely distributed genus of trees in North America, since there is hardly a state in the United States in which some one or a few of the species do not grow. They have little value as timber trees since only 1 species reaches a size large enough to produce timber. The fruit of the Junipers, usually called berries, is the most distinctive character of the trees. These berries are in reality cones, but have the appearance of a berry. In addition to the species described here, the Common Juniper (Juniperus communis, Linnaeus) is also native to this State. It is usually a shrub, and found only locally in the eastern and northern parts of the State.

FORM—An average-sized tree usually attaining a height of 25-40 ft. with a diameter of 1-2 ft., but may reach a maximum height in the south of 120 ft., with a diameter of 3-4 feet. Crown usually deep, dense, narrow, and conic, but occasionally in old specimens broad, spreading, and round-topped.

BARK—Rather thin, often grooved, reddish-brown, peeling off into rather long, narrow, stringy, film-like strips. See Fig. 52.

TWIGS—Slender, usually four-sided and green as long as leaves persist, but after leaves have fallen are round and reddish-brown.

BUDS—Inconspicuous because they are small in size and covered with leaves.

LEAVES—Two kinds are recognized, scale-shaped and awl-shaped. Scale-shaped form is typical of the tree. They are about 1/16 of an inch long, ovate, closely appressed, acute to round at apex, dark bluish-green, sometime glandular on back, and four-ranked giving the twig an angular appearance. The awl-shaped, which usually occur on young trees or on vigorous shoots, are narrow, sharp-pointed, spreading, scattered, not overlapping, opposite, in 2s or in 3s.

FLOWERS—Appear about April or May. Staminate and pistillate flowers usually occur on different trees but occasionally are found on the same tree. Staminate short-stalked, yellow, consisting of about 10 stamens, and produced in great numbers. Pistillates small, with about 6 spreading, sharp-pointed, bluish scales.

FRUIT—A dark blue berry about ¼ of an inch in diameter, often covered with a white bloom and maturing at the end of the first or second season. Flesh sweet and covering 1-2 seeds. Fruit often persists during the winter and furnishes food for birds. Some think it necessary for the seed to pass through the alimentary canal of birds to insure optimum germination.

WOOD—Non-porous; without resin passages; with distinct red heartwood and nearly white sapwood; light, soft, fragrant, weak, durable in contact with the soil, easily worked. Weighs 30.70 lbs. per cubic foot. Used largely for fence posts, lead pencils, moth-proof chests and closets, interior finish, furniture, rustic work, pails, and tubs.

DISTINGUISHING CHARACTERISTICS—The Red Cedar, also known as Red Juniper, Cedar, and Savin, can readily be distinguished from all the other conifers of Pennsylvania except the Common or Dwarf Juniper by its berry-like fruit, if present. The Common Juniper does not have the scale-like leaves of the Red Cedar, and the awl-shaped leaves of the Red Cedar are generally darker on the upper surface and not regularly in 3s. The awl-shaped leaves of the Common Juniper occur regularly in 3s, are larger, sharper-pointed than those of the Red Cedar and diverge almost at right angles. The Red Cedar also reaches a larger size and is usually more erect, but bears less conspicuous winter buds. See "Distinguishing Characteristics" under White Cedar for comparisons with this species.

RANGE—Nova Scotia west to Ontario and South Dakota, south to Florida and Texas. The Common Juniper has the widest range of any tree in the northern hemisphere.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. Usually solitary and scattered in abandoned fields and along fences. Sometimes in dense pure stands. Pure stands occur in Franklin, Lancaster, Montgomery, and Bucks counties. Common on red shale soil.

HABITAT—It will accept almost any location from a swamp to a poor rocky cliff but reaches its best development in the swamps and alluvial soils of the southern states. Limestone soil is favorable to its growth. Abundant light is necessary for optimum development but it will tolerate shade for many years.

IMPORTANCE OF THE SPECIES—The Red Cedar produces a valuable wood but grows very slowly. Other more valuable and more rapid growing species will thrive upon the same areas and bring much earlier returns. It is also subject to the attack of numerous fungous diseases, especially when young. Many ornamental varieties and forms have been developed which are highly prized for landscape work.

THE WILLOW FAMILY—SALICACEAE.

The Willow family comprises about 200 species belonging to two genera, the well-known Willows and the Aspens or Poplars. The members of this family comprise both trees and shrubs found chiefly in the north temperate and arctic zones. A few shrubby species extend far into the arctic regions. They usually prefer moist habitats but may also be found on drier locations. One is very apt to associate the Willows with wet habitats.

The flowers appear in early spring, usually before the leaves. The staminate (male) and pistillate (female) flowers are produced on different trees. A tree bearing staminate flowers does not bear the pistillate. As a consequence one will find fruit only upon pistillate trees. The pistillate flowers are fertilized by insects, usually bees, which carry the pollen from the staminate flowers. The fruit consists of capsules which split into 2-4 parts and are arranged in drooping tassel-like clusters. The fruit matures in late spring at about the same time that the leaves reach their full size. The seeds are small and surrounded by a dense covering of long white hairs which aid considerably in their dispersal. The seeds must germinate soon after they mature or they will lose the power of germination. The bark is usually rather bitter.

The representatives of both genera are noted for their remarkable ability to grow both from root and shoot cuttings. One can cut a small twig from a tree, put it into moist ground, and feel assured that it will grow. They also sprout very freely from stumps irrespective of the age of the stump. The following key will distinguish the two genera belonging to this family.

KEY TO THE GENERA.

	Page.
1. Buds with one bud-scale; bracts of the catkins entire; stamens fewer than 10, usually 2, ...Salix	88
1. Buds with more than one bud-scale; bracts of the catkins fringed or lobed; stamens usually 10 or more, ...Populus	94

THE WILLOWS—SALIX (Tourn.) L.

This genus comprises about 175 species of which number about 100 species are native to North America and about 15 species to Pennsylvania. The members of this family are met as trees and shrubs. Most of our native species are small trees or shrubs. Those which attain tree-size are usually found near buildings and have been introduced.

The Willows produce wood which is light, soft, not durable, and weak. It is of little commercial importance. The value of the Willows lies in the shoots or rods which are used in the manufacture of baskets and furniture. Some reach a large enough size to be used for saw lumber but the trunks are usually of a poor shape and also begin early to decay in the center. They are valuable to bind the border of streams by means of their interlacing roots and thus prevent erosion. They may also be used to prevent the movement of shifting sands.

Few trees possess such a tenacious vitality as the Willows. They live a long time after they appear to be dying and repair broken parts very readily and often replace them with new growth. They reproduce freely by means of sprouts, cuttings, and seeds. On very wet situations, like islands or the borders of streams, they often form dense thickets to the exclusion of almost all other growths.

The Willows as a group are easily recognized even by a layman. They have a characteristic external appearance which one can soon learn to appreciate. It is, however, difficult to distinguish the different Willows from each other. They sport and hybridize freely. Very often one leaves a Willow in despair because of the fact that it was impossible to identify it. Only 4 of the 15 or 20 Willows found in Pennsylvania are described below because many of them are mere shrubs and others have been introduced from the eastern hemisphere. The Weeping Willow (Salix babylonica L.) (Fig. 37) is very common in cultivation and in some localities it has escaped cultivation. It can readily be distinguished by its drooping branches. The Crack Willow (Salix fragilis L.) is a native of Europe. It is common along our streams where it reaches a large tree-size. The lateral branches are very brittle and after a windstorm the ground around the tree is usually covered with branchlets which have cracked off, whence the name Crack Willow.

KEY TO THE SPECIES.*

			Page.
1.	Leaves persistently hairy at least beneath,	S. rostrata	93
1.	Leaves smooth or nearly so when mature,	2	
2.	Large tree; leaves narrowly lanceolate,	S. nigra	90
2.	Shrub or small tree rarely 20 feet tall; leaves broadly lanceolate,	3	
3.	Capsules pubescent; petioles and stipules not glandular; buds large,	S. discolor	92
3.	Capsules glabrous; petioles and stipules glandular; buds small,	S. lucida	91

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*It is not intended that this key will enable one to distinguish all the species of Willow found in Pennsylvania. It simply aims to point out the distinguishing characteristics of the four species which are described here. Other species may be distinguished by the use of Porter's Flora of Pennsylvania.

BLACK WILLOW.

Salix nigra, Marshall.

FORM—Largest of our native tree-willows, usually 25-30 ft. high with a diameter of 10-20 inches, but may reach a height of 60-80 ft., with a diameter of 2-3 feet. Trunks usually crooked, often inclined and occurring in small groups. Crown wide, open and round-topped.

BARK—Thick, rough, deeply furrowed, blackish-brown, with wide ridges covered with thick scales. Ridges of bark often connected by narrow, transverse or diagonal ridges.

TWIGS—Slender, smooth, brittle, drooping, bright reddish-brown to orange colored.

BUDS—Alternate, small, about ⅛ of an inch long, sharp-pointed, reddish-brown, covered by a single scale.

LEAVES—Alternate, simple, narrowly-lanceolate, very long-pointed, tapering or slightly rounded at base, finely serrate on margin, usually smooth and dark green above, pale green below.

LEAF-SCARS—Alternate, narrow, with 3 bundle-scars in a lunate line. Terminal scar often larger than lateral ones. Stipule-scars large and prominent.

FLOWERS—Appear in March or April before the leaves. Staminate and pistillate flowers occur on separate trees, and both are borne in drooping aments or catkins from 1-3 inches long.

FRUIT—A reddish-brown, smooth, ovate capsule which splits open and liberates many small seeds. Seeds covered with a dense tuft of fine long hairs.

WOOD—Diffuse-porous; with very inconspicuous medullary rays; reddish-brown, soft, weak, firm, close-grained, not durable. Weighs about 28 lbs. per cubic foot. Used mainly for fuel and charcoal.

DISTINGUISHING CHARACTERISTICS—The Black Willow is the largest of our native Willows. The rough thick-scaled, blackish-brown bark is characteristic. The narrowly-lanceolate and short-petioled leaves which are always smooth or nearly so are also distinctive. The trunks often occur in small groups. The slender drooping branches are easily broken off at their ends.

RANGE—New Brunswick to Florida, west to Dakota, Kansas, southern Arizona and central California.

DISTRIBUTION IN PENNSYLVANIA—Throughout the State. Most common in eastern and southern parts.

HABITAT—Prefers moist or wet situations like banks of streams and lakes. Requires plenty of light. Occasionally found on moist, gravelly and sandy soil.

IMPORTANCE OF THE SPECIES—The Black Willow is the largest tree-willow native to our flora and is very conspicuous in its appearance. It is of no present or prospective value except as a soil conserver and to a limited extent as a producer of fuel wood and charcoal. Other more valuable and more attractive trees should be grown in place of it.

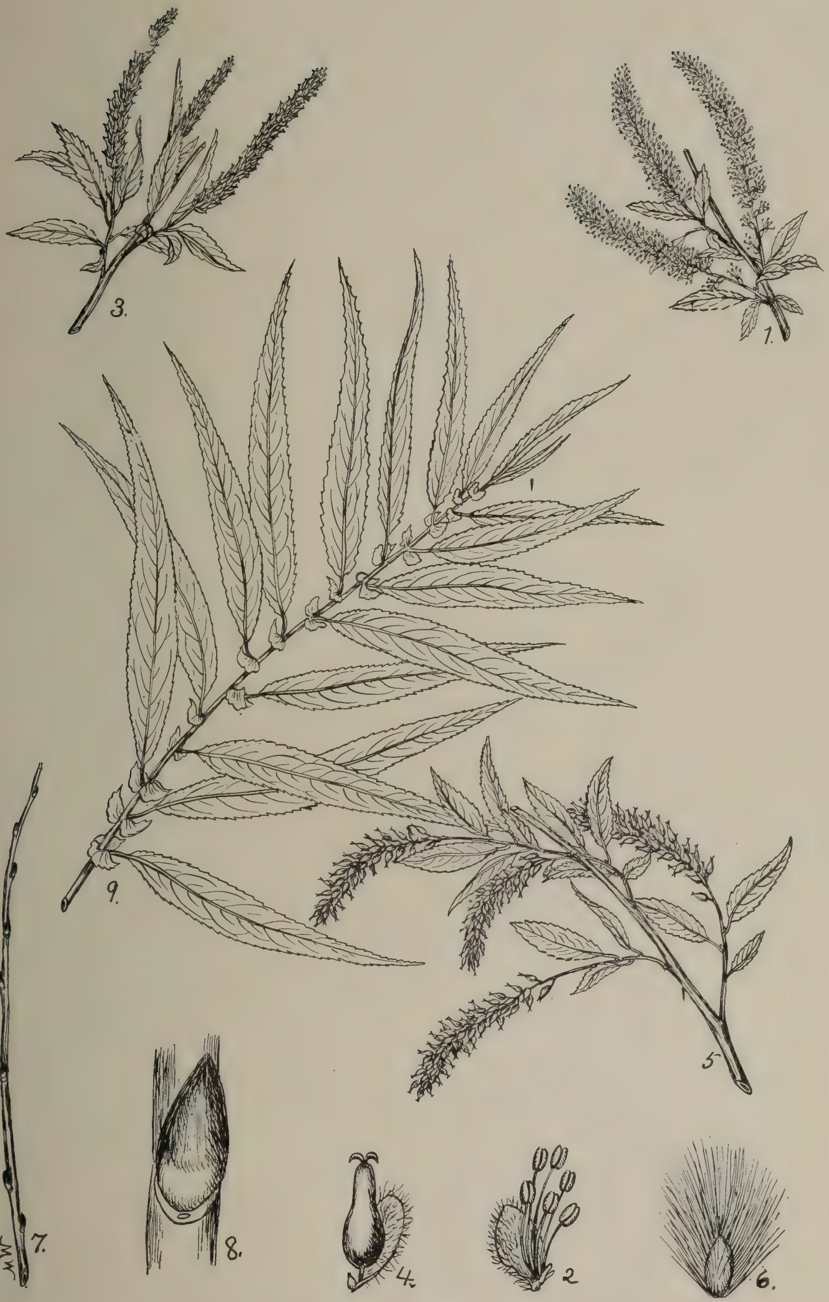

PLATE XXVIII. BLACK WILLOW.

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. A fruiting branch, x ½.
6. A seed with hairs, enlarged.
7. A winter twig, x ½.
8. Section of a winter twig with bud and leaf-scar, enlarged.
9. A leafy branch, x ½.

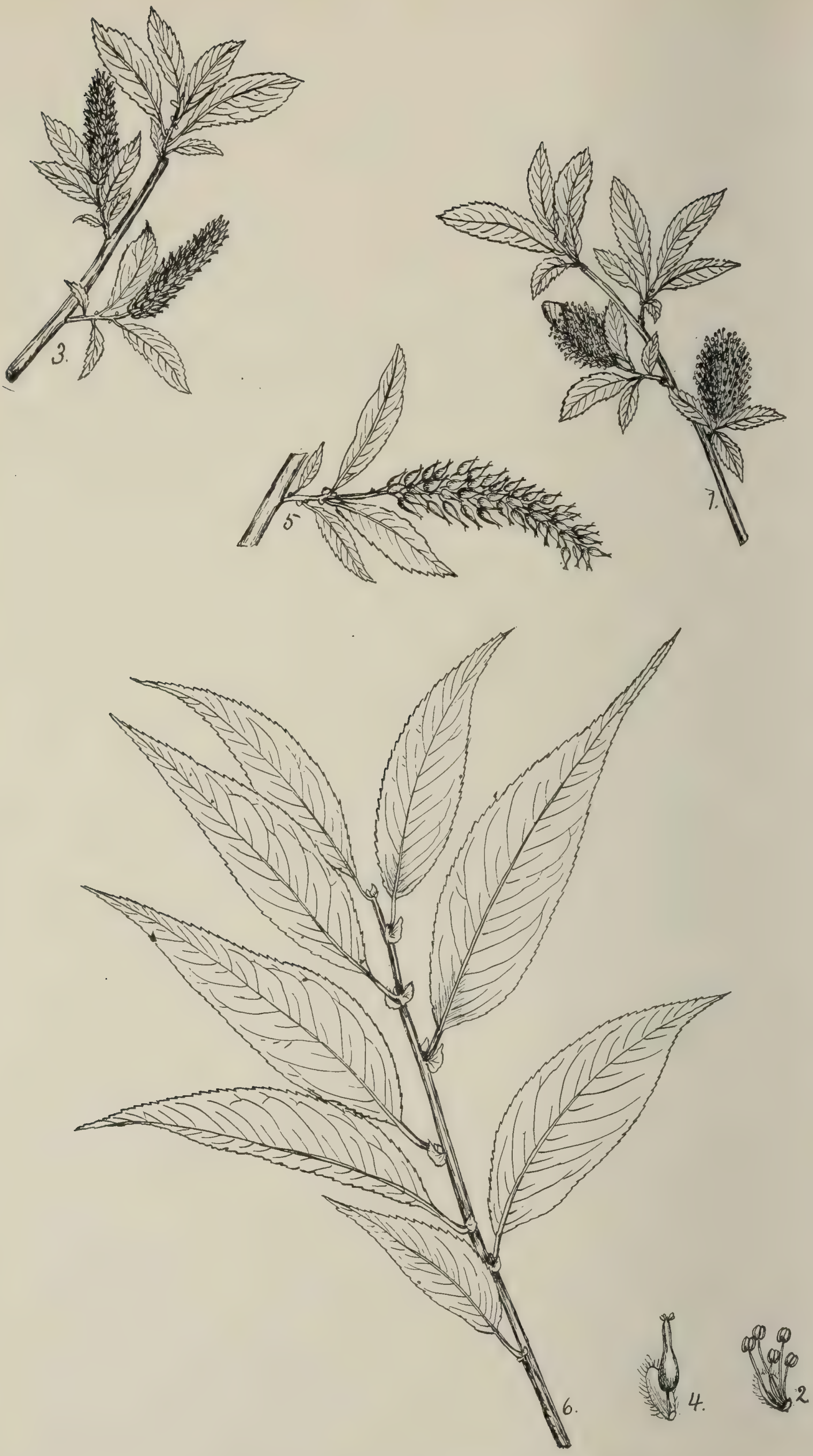

PLATE XXIX. SHINING WILLOW.

1. A staminate flowering branch, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, slightly enlarged.
5. Section of a fruiting branch, x ½.
6. A branch with mature leaves, x ½.

SHINING WILLOW.

Salix lucida, Muhlenberg.

FORM—A shrub or small tree sometimes reaching a height of 25 ft. with a diameter of 8 inches. Trunk short, bearing rather ascending branches which form a rather symmetrical and broad crown.

BARK—Smooth, thin, bitter, brown to reddish-brown.

TWIGS—Shining, yellowish-brown, later dark brown.

BUDS—Alternate, smooth, ovate, pointed, about ¼ of an inch long, covered by a single yellowish-brown scale.

LEAVES—Alternate, simple, broadly lanceolate to ovate, long-pointed at apex, tapering or rounded at base, finely toothed on margin, smooth and shining above, paler below.

LEAF-SCARS—Alternate, somewhat raised, lunate, with 3 conspicuous bundle-scars.

FLOWERS—Appear in catkins about April before the leaves have unfolded. Staminate and pistillate flowers occur on separate trees. The staminate have five stamens, and are arranged in dense flowered catkins about 1 to 1½ inches long. The pistillate are arranged in slender catkins from 1½-2 inches long.

FRUIT—A narrowly-ovoid, smooth, dull, evidently-stalked, straw-colored to pale brown or greenish capsule which is evidently-rounded at the base.

WOOD—Same as that of other Willows. See description under Black Willow, page 90.

DISTINGUISHING CHARACTERISTICS—The Shining Willow, also known as Glossy Willow, may be distinguished by its shining leaves which are lanceolate to ovate in outline, and by its glandular petioles and stipules. The shining brownish or yellowish twigs are also characteristic. The capsules are smooth and the staminate flowers usually have 5 stamens.

RANGE—Newfoundland to Manitoba, south to Pennsylvania, west to Kentucky and Nebraska.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State except in the southern part.

HABITAT—Prefers wet habitats. Common along streams, on islands, and in wet semi-boggy situations.

IMPORTANCE OF THE SPECIES—The Shining Willow is a very common shrub or small tree in wet situations throughout this State. The wood is of no commercial importance. The tree often acts as a soil binder upon areas where erosion is to be feared. It is also one of the most attractive of our small Willows, both in its natural haunts and artificial environments.

GLAUCOUS WILLOW.

Salix discolor, Muhlenberg.

FORM—A shrub or small tree usually from 6-15 feet high but may reach a height of 25 ft. with a diameter of 8 inches. Trunk short and bearing stout ascending branches which form a round-topped crown.

BARK—Thin, smooth, occasionally scaly, reddish-brown.

TWIGS—At first hairy, later smooth, stout, reddish-purple to dark green, rather flexible.

BUDS—Alternate, closely appressed, flattened, pointed, about ¼-½ of an inch long, covered by a solitary shining reddish-purple scale. Flower-buds much larger than leaf-buds.

LEAVES—Alternate, simple, elliptic to oblong-lanceolate, sharp-pointed at apex, rounded at base, coarsely toothed on margin, glaucous or white beneath, green and smooth above. Petioles and stipules not glandular.

LEAF-SCARS—Alternate, somewhat raised, lunate, contain 3 bundle-scars.

FLOWERS—Appear in March on twigs of previous season's growth before the leaves unfold. Staminate and pistillate flowers occur on separate trees; catkins densely flowered, with brown-tipped bracts.

FRUIT—A large, hairy, long-beaked, light brown capsule.

WOOD—Same as that of other Willows. See description under Black Willow, page 90.

DISTINGUISHING CHARACTERISTICS—The Glaucous Willow, also known as Pussy Willow, may be distinguished by its lanceolate to elliptic leaves which are smooth and bright green above and glaucous beneath. The blossoms are thick, about half as wide as long. Capsules are pubescent. The scales of the blossoms are clothed with long shining hairs.

RANGE—Nova Scotia and Manitoba, south to Delaware and Missouri.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State. Rather common along the main streams and their tributaries.

HABITAT—Prefers wet habitats such as one finds along streams, on the border of lakes, in swamps and semi-boggy situations. Occasionally on moist hillsides. Planted specimens often grow on rather dry situations.

IMPORTANCE OF THE SPECIES—The Glaucous Willow produces wood which is of no special commercial importance. The main value of the tree lies in its attractive blossoms which appear early in spring before the leaves have unfolded. It also possesses a rather handsome form and attractive bark.

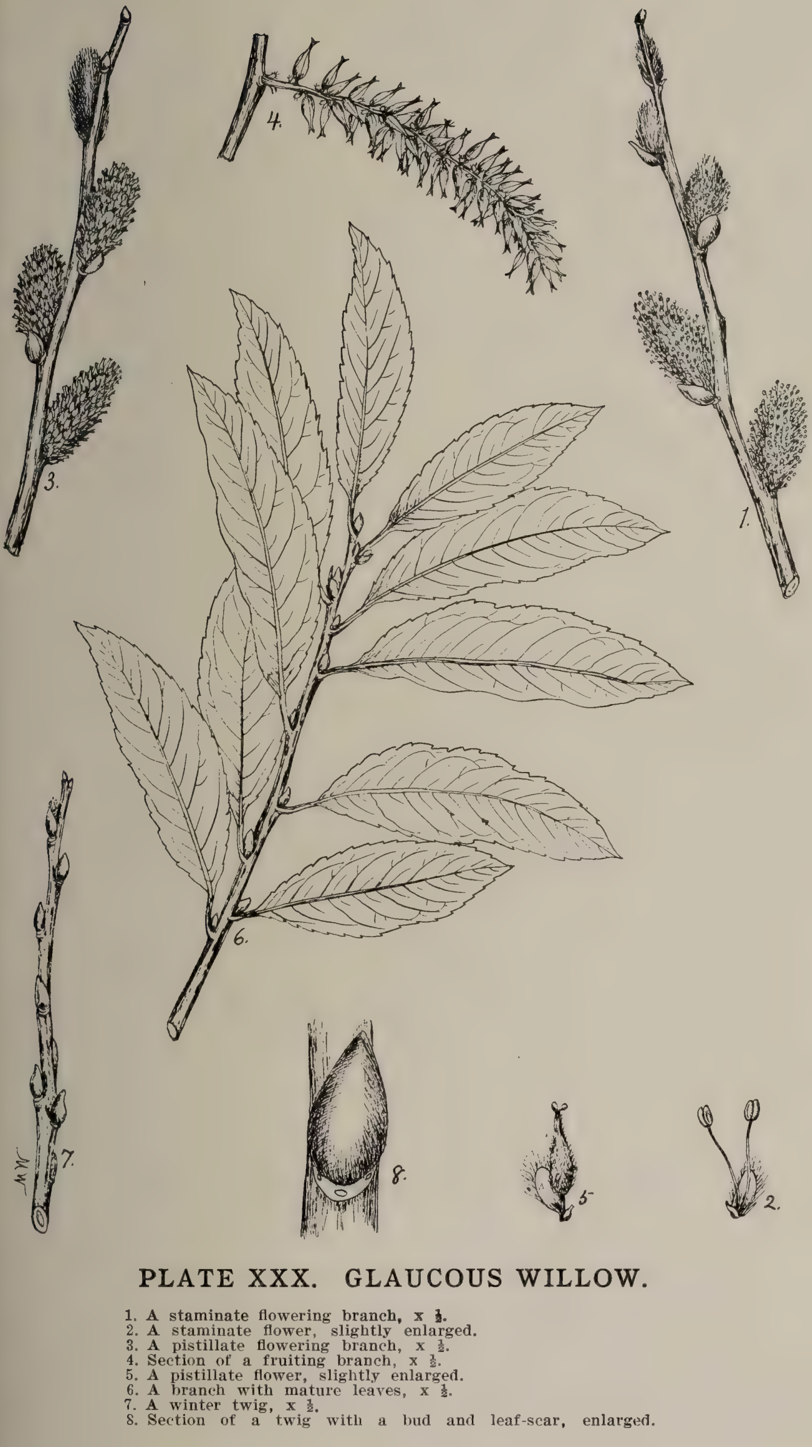

PLATE XXX. GLAUCOUS WILLOW.

1. A staminate flowering branch, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flowering branch, x ½.
4. Section of a fruiting branch, x ½.
5. A pistillate flower, slightly enlarged.
6. A branch with mature leaves, x ½.
7. A winter twig, x ½.
8. Section of a twig with a bud and leaf-scar, enlarged.

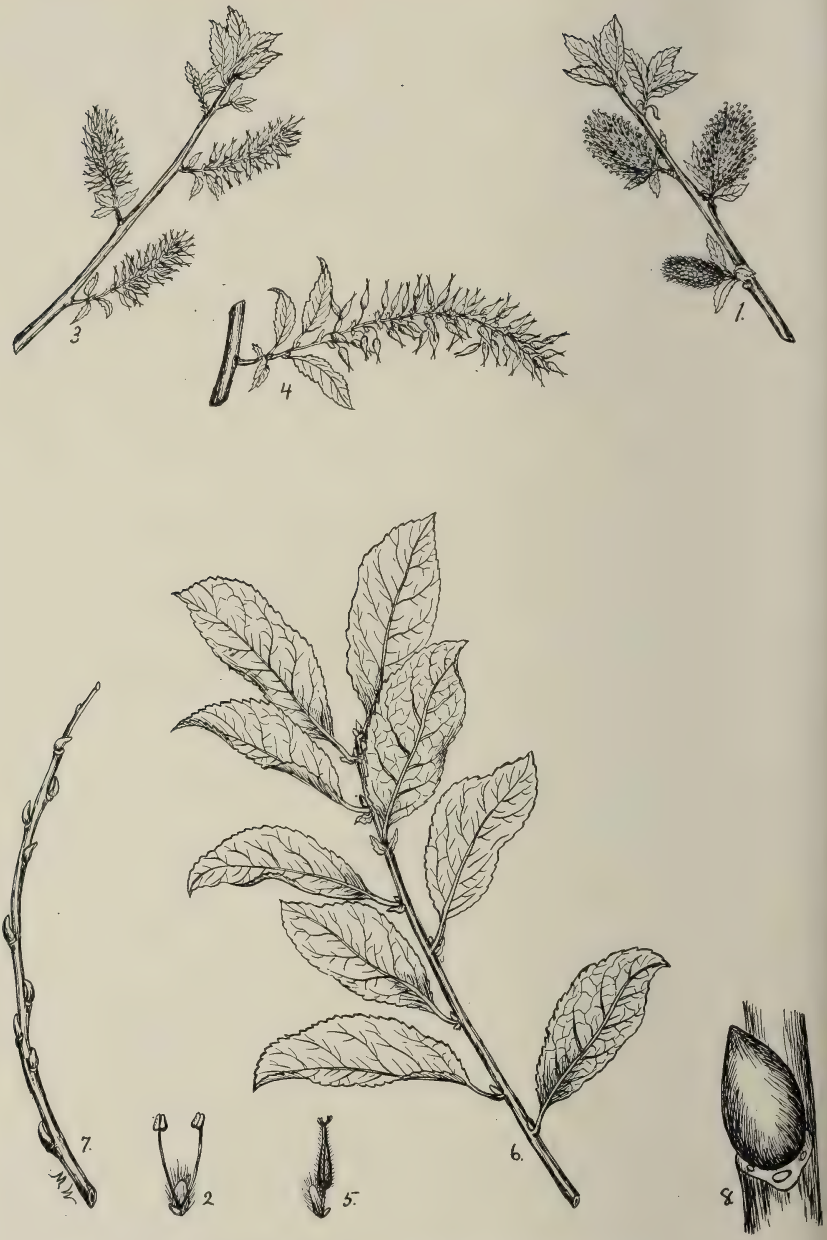

PLATE XXXI. BEAKED WILLOW.

1. A staminate flowering branch, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flowering branch, x ½.
4. Section of a fruiting branch, x ½.
5. A pistillate flower, slightly enlarged.
6. A branch with mature leaves, x ½.
7. A winter twig, x ½.
8. Section of a twig with a bud and leaf-scar, enlarged.

BEAKED WILLOW.

Salix rostrata, Richards.

FORM—Shrub or small tree, rarely exceeding 20 ft. in height, usually 6-10 ft. high and 3-4 inches in diameter. Trunk short, often inclined and twisted. Crown broad and round-topped.

BARK—On trunk thin, smooth, sometimes shallowly fissured, usually scaly, bitter, reddish, grayish, or olive-green.

TWIGS—At first hairy, later smooth, slender, purplish to brown, with projecting leaf-scars and few lenticels.

BUDS—Alternate, oblong, narrow, blunt-pointed, about ¼ of an inch long, covered by a single light chestnut-brown scale.

LEAVES—Alternate, simple, elliptic to oblong, lanceolate, short-pointed to sharp-pointed at apex, wedge-shaped or rounded at base, sparingly toothed or entire on margin, dull green and smooth on upper surface, pale green and prominently veined and hairy on lower surface, 1-3 inches long, and ½-1 inch wide.

LEAF-SCARS—Alternate, conspicuous, lunate, somewhat elevated, with 3 conspicuous bundle-scars.

FLOWERS—Appear about April or May before or during the unfolding of the leaves. Pistillate and staminate flowers occur on different trees. The staminate have 2 stamens with smooth filaments and are arranged in erect and terminal catkins about 1 inch long. The pistillate have hairy and evidently-stalked ovaries and are arranged in catkins about 2-2½ inches long.

FRUIT—A narrowly-ovoid, hairy, evidently-beaked and stalked capsule.

WOOD—Diffuse-porous; with very inconspicuous medullary rays. Similar to the wood of other Willows. See description under Black Willow, page 90.

DISTINGUISHING CHARACTERISTICS—The Beaked Willow, also known as Bebb's Willow, may be distinguished by its elliptic to oblong-lanceolate leaves which are usually prominently veined and hairy on lower surface. The pubescent, evidently-stalked and beaked capsules are also characteristic. The bracts of the catkins are yellow while those of the closely related Glacuous Willow are reddish-brown.

RANGE—From the valley of the Mackenzie River within the Arctic Circle and the valley of the St. Lawrence to Alaska, south to Pennsylvania, and west to Minnesota and Idaho. One of the most widely distributed species of Willow.

DISTRIBUTION IN PENNSYLVANIA—Found in the northeastern and northern parts of the State.

HABITAT—Prefers moist or wet situations but will grow on dry hillsides. Common in swamps and along the borders of streams. In Canada often produces twisted stems which form almost impenetrable thickets.

IMPORTANCE OF THE SPECIES—This species is of no commercial and of little economic importance in Pennsylvania. This is its southern limit. It remains small and is not abundant. Like most of the Willows, it grows in wet situations and will aid in binding the soil, thus preventing erosion and wash-outs.

THE ASPENS AND COTTONWOODS—POPULUS (Tourn.) L.

This genus comprises about 27 species native to the north temperate and arctic zones, of which number 19 are native to North America and 4 to Pennsylvania.

The trees belonging to this genus have many common names, as Aspens, Cottonwoods, Poplars, or Popples. Although some of them are called Poplar, still they are in no way related to the well-known Yellow Poplar or Tulip Tree which belongs to the Magnolia family.

The leaves of some of the representatives become very conspicuous on account of their trembling or quaking habit. This fluttering of the leaves, even when only a slight breeze is at hand, is due to their laterally compressed leaf-stalks. The buds of a few species are evidently resinous and often pungent. Possibly no group of trees, except the Willows, is so well equipped to disseminate its seeds. The seeds are very light, produced in great abundance, and furnished with a dense covering of long white hairs which aid in their dispersal.

The wood of the members of this genus is just beginning to be of commercial importance. It was formerly despised but is now used for various purposes, especially for paper pulp. These trees have some valuable merits in that they grow very fast, often on situations where other species refuse to grow, especially in wet places, and may easily be reproduced by cuttings, sprouts, or seeds.

In addition to the 4 species described and contained in the subjoined key, a few other species are rather common throughout the State especially as ornamental trees. The White or Silver-leaf Poplar (Populus alba L.) is a native of Europe and Asia but very common as an ornamental tree. It can be distinguished by its lobed leaves, covered by a dense white persistent wool on the lower surface, and by its twigs, usually covered with white cottony felt which rubs off easily. The Lombardy Poplar (Populus nigra var. italica Du Roi) is frequently cultivated in this State. It can best be distinguished by its form (Fig. 36). The lateral branches are almost erect forming a high but narrow crown. The leaves have flattened petioles, are finely toothed, smooth, and sharp-pointed. The Balm of Gilead (Populus candicans Ait.), sometimes regarded a variety of the Balsam Poplar, is occasionally found as a cultivated tree and frequently escapes cultivation. It can be recognized by large resinous buds, reddish-brown twigs, and its ovate leaves with round or channeled petioles and heart-shaped base. The leaves of the closely related Balsam Poplar (Populus balsamifera L.) do not have a cordate base.

SUMMER KEY TO THE SPECIES.

Page.

1. Leaves with round or channeled petioles; twigs with orange colored pith, **P. heterophylla** 98
1. Leaves with flattened petioles; twigs with white pith, ... 2

2. Leaves broadly deltoid, abruptly acuminate; stigma-lobes expanded in all directions, ... **P. deltoides** 99
2. Leaves broadly ovate to nearly round, usually acute at apex; stigma-lobes thread-like, ... 3

3. Leaves finely serrate on margin; bark greenish-white, ... **P. tremuloides** 96
3. Leaves coarsely dentate on margin; bark yellowish-gray to black, **P. grandidentata** 97

WINTER KEY TO THE SPECIES.

1. Terminal buds ½ to ¾ of an inch long, decidedly resinous; lateral branches with a tendency to become vertical, ... **P. deltoides** 99
1. Terminal buds about ¼ of an inch long, devoid of resin or only slightly resinous; lateral branches without the vertical tendency, ... 2

2. Twigs with orange-colored pith, ... **P. heterophylla** 98
2. Twigs with white pith, ... 3

3. Buds smooth, glossy, conical, sharp-pointed; often incurved and closely appressed, bark greenish-white, ... **P. tremuloides** 96
3. Buds downy, dull, ovate, blunt-pointed, straight, divergent; bark yellowish-gray to black, ... **P. grandidentata** 97

AMERICAN ASPEN.

Populus tremuloides, Michaux.

FORM—A small tree usually 30-40 ft. high but may reach a height of 80 ft. with a diameter of 20 inches. In Pennsylvania usually very small. Trunk continuous, tapering, bearing slender, brittle, and rather ascending lateral branches. Crown high, narrow, rather round-topped.

BARK—On old trunks thick, deeply fissured and black; on upper portion of trunk and young stems yellowish-green to white, with dark blotches below the branches. Usually whiter at high altitude.

TWIGS—Rather slender, reddish-brown, glossy, smooth, round, sometimes covered with a scaly bloom; marked by reddish-yellow lenticels; roughened by leaf-scars; pith white and 5-angled.

BUDS—Alternate, narrowly conical, sharp-pointed, smooth, shiny, usually appressed, often incurved; covered by 6-7 reddish-brown, smooth, shiny, bud-scales; basal scale of lateral buds outside.

LEAVES—Alternate, simple, ovate to nearly round, cordate to truncate at base, acute a apex, finely serrate on margin, 1½-2 inches long, thin, dark green and shiny above, pale green below. Leaf-stalks laterally flattened.

LEAF-SCARS—Alternate, large, conspicuous, lunate, with a cork-like surface; bundle-scar 3, simple or compounded. Stipule-scars linear, blackish, rather distinct.

FLOWERS—Appear about April. Staminate and pistillate flowers occur on different trees Staminate aments drooping, 1½-2½ inches long, bearing many closely packed individual flower with 6-12 stamens. Pistillate aments drooping, 1½-2½ inches long; when mature 4 inches long bearing relatively few individual flowers with thick stigmas divided into thread-like lobes.

FRUIT—An oblong-conical capsule, 2-valved, light green, borne on a drooping stalk about inches long. Seeds light brown, surrounded by a mat of long, soft, white hairs.

WOOD—Diffuse-porous; medullary rays very fine and indistinct; pores very minute, invisibl without a lens. Fine in texture, light brown to white in color, neither strong nor durable Weighs 25 lbs. per cubic foot. Used for paper pulp, boxes, jelly buckets, lard pails, spice kegs wooden dishes.

DISTINGUISHING CHARACTERISTICS—The American Aspen, also known as Quaking Aspen Trembling Aspen, Small-toothed Aspen, Popple, Poplar, and Aspen, may be distinguished b the round or ovate leaves which have a finely serrate margin and are short-pointed. Th petioles of the leaves are decidedly flattened which causes them to tremble or flutter in respons to even a light breeze, whence the name Trembling Aspen. The alternate, sharp-pointed, conical often incurved, closely appressed, shiny buds are also characteristic. The buds of the closel related Large-toothed Aspen are stouter, not so sharp-pointed, usually divergent, and covere with a flour-like, crusty, pale, woolly substance. The twigs are reddish and usually smooth whil those of the Large-toothed Aspen are yellowish-brown often pale-downy or pale-scaly. The later branches are more ascending and the bark is lighter in color than that of the Large-toothe Aspen. The bark is yellowish-green to white often marked with dark blotches.

RANGE—A transcontinental species extending from Newfoundland to the Hudson Bay regio and Alaska, south to Pennsylvania and along the mountains to Kentucky, west to th Rocky Mountains, Mexico, and California. The widest range of any species of tree in Nort America.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State. Most comm in the mountainous part.

HABITAT—Found upon practically all soil conditions except swamps. Prefers dry situation Common in abandoned fields, on cut-over areas and burns. Frequently mixed with Scrub Oa which shades out in time.

IMPORTANCE OF THE SPECIES—The American Aspen is of no commercial importance Pennsylvania. It remains too small and is too local in its distribution. Next to Spruce ar Hemlock it is the principal pulpwood of the country. It is also beginning to be used f lumber. The wood is white and turns well. Ordinarily it is a poor competitor in the fore but it does overcome the Scrub Oak upon burnt-over areas by shading it out. It is also valuab as a temporary shelter species for other valuable trees.

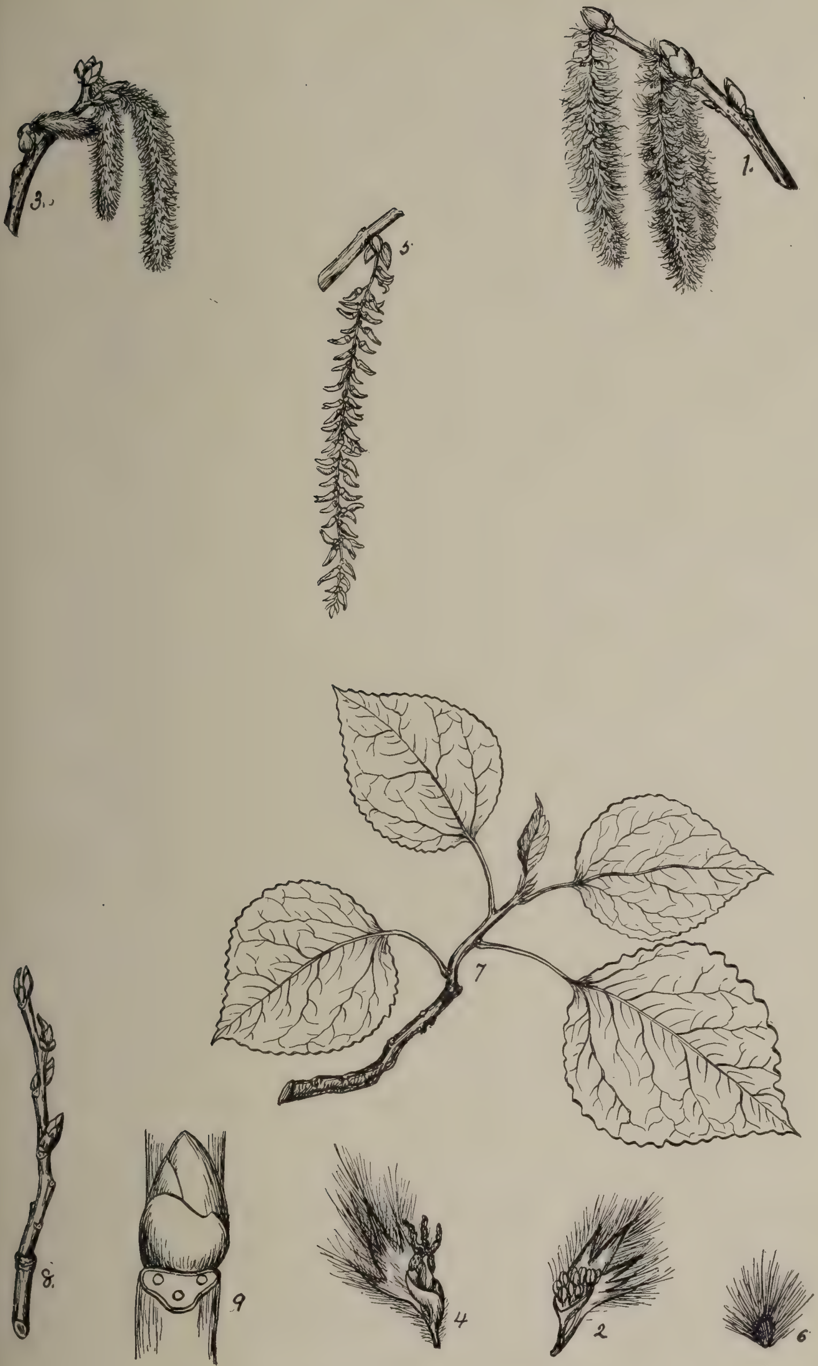

PLATE XXXII. AMERICAN ASPEN.

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. Section of a fruiting branch, x ½.
6. A seed with hairs, enlarged.
7. A branch with mature leaves, x ½.
8. A winter twig, x ½.
9. Section of a twig with a bud and a leaf-scar. enlarged.

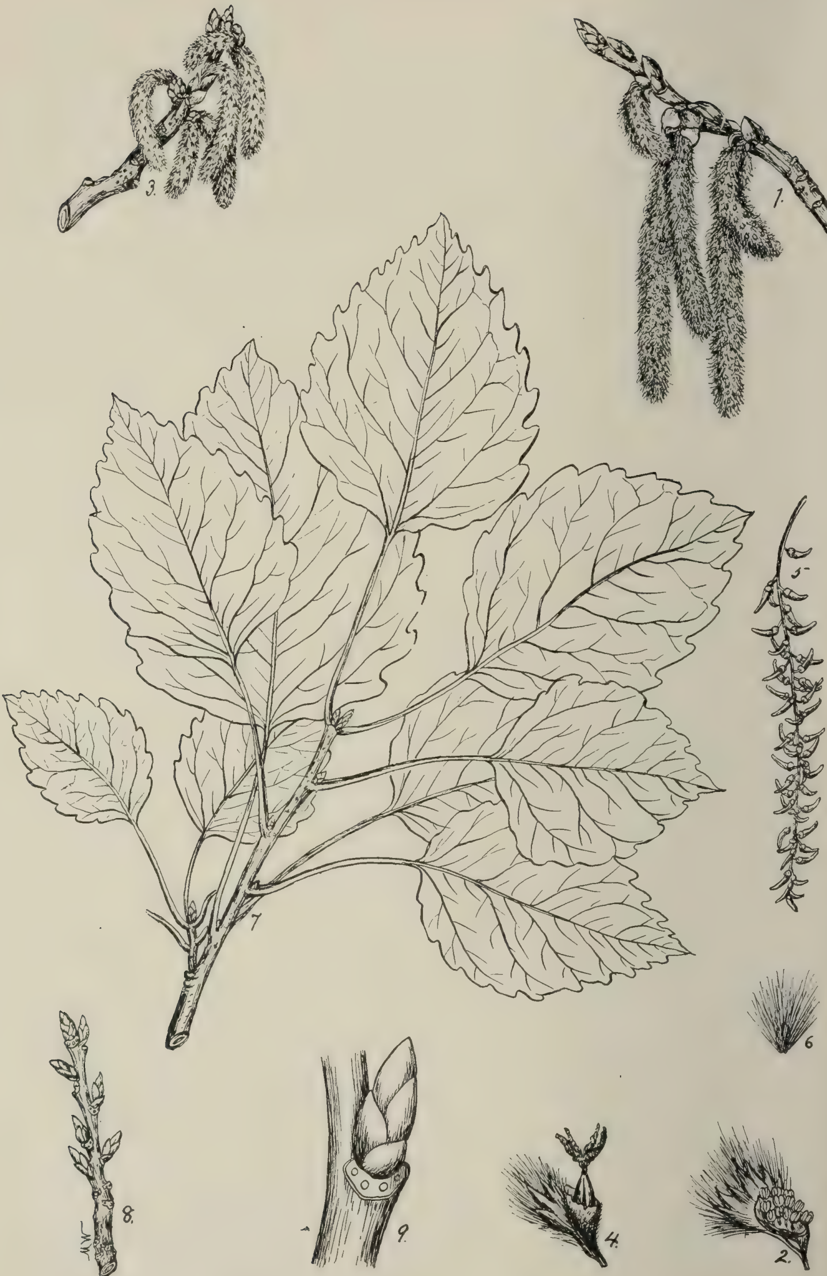

PLATE XXXIII. LARGE-TOOTHED ASPEN.

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. A fruiting catkin with capsules, x ½.
6. A seed with hairs, enlarged.
7. A branch with mature foliage, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, enlarged.

LARGE-TOOTHED ASPEN.

Populus grandidentata, Michaux.

FORM—Usually a small tree 30-40 ft. high but may reach a height of 70 ft. with a diameter of 2 feet. More frequent and larger in this State than the American Aspen. Trunk continuous and tapering. Crown often irregular, due to the absence of branches which have been broken off on account of their brittleness. Branches usually less ascending than those of the American Aspen.

BARK—Near the base of old trunks black, very rough, thick, hard, does not heal over branch wounds rapidly. Large smooth surfaces found on flat ridges between fissures. Smaller branches similar to those of the American Aspen but with a more pronounced yellow color. See Fig. 95.

TWIGS—Rather stout, reddish to yellowish-brown, round, often covered with a coating of pale, woolly, crusty down which occasionally peels off in small flakes.

BUDS—Alternate, ovate to conical, pointed, dusty, dull, usually divergent, covered by 6-7 light chestnut-brown scales which are often coated with a dusty flour-like mat of a pale, woolly substance. Basal scale of lateral buds on outside.

LEAVES—Alternate, simple, broadly-ovate, wedge-shaped to cordate at base, acute to acuminate at apex, coarsely dentate on margin, 3-4 inches long, dark green above, pale green below. Leaf-stalks laterally flattened.

LEAF-SCARS—Same as leaf-scars of American Aspen, page 96. Stipule-scars are less distinct.

FLOWERS—See "Flowers" under American Aspen, page 96.

FRUIT—An ament bearing scattered, light, green, 2-valved capsules which contain minute dark brown seeds surrounded by a mat of long white hairs.

WOOD—Same as American Aspen, page 96.

DISTINGUISHING CHARACTERISTICS—The Large-toothed Aspen, also known as Popple and Poplar, may be distinguished by its coarsely wavy-toothed leaves, larger than those of the American Aspen which it closely resembles. See "Distinguishing Characteristics" under the latter. It does not have the resinous buds, nor the ridged bark on the twigs, nor the deltoid leaves so characteristic of the Cottonwood. The bark is often covered with oyster-shell-like bodies which are the armored portion of the oyster-shell scale. Many small trees are killed by this scale.

RANGE—Nova Scotia and Ontario south to Pennsylvania, along mountains to North Carolina and west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Rather common throughout the State especially on lumbered and burnt-over areas, in abandoned fields, and on charcoal hearths. Usually found in mixture, but occasionally in small pure stands.

HABITAT—Prefers rather rich moist soil, but is also found on dry gravelly soil. Usually large on moist situations and smaller, often scrubby, on very dry situations. Frequent associates are Birch, Bird Cherry, Shad Bush, and Scrub Oak.

IMPORTANCE OF THE SPECIES—The Large-toothed Aspen is of no commercial importance in this State. It is of value in our lumbered areas because it covers the soil rapidly, acts as a soil-conserver, and often as a soil-improver. It may also act as a temporary shelter for more valuable species while they are young and establishing themselves. It also aids in shading out our most aggressive forest weed—Scrub Oak.

DOWNY POPLAR.

Populus heterophylla, Linnaeus.

FORM—In the north usually a small tree from 30-50 ft. high; in the south may reach a height of 100 ft. with a diameter of 3 ft. Crown high, rather broad and round-topped. Trunk short, continuous, and tapering.

BARK—On old trunks thick, light reddish-brown, rough, broken by long fissures into long narrow plates. On younger trunks and large branches thinner, not so rough; fissures shallower and ridges smoother than on old trunks.

TWIGS—Stout, light yellowish, marked by a few scattered pale lenticels, roughened by elevated leaf-scars; pith orange-colored.

BUDS—Alternate, broadly ovate, slightly resinous, bright reddish-brown, covered with 4-7 scales which are slightly pubescent towards the base. Leaf-buds about ¾ of an inch long. Flower-buds about ½ of an inch long.

LEAVES—Alternate, simple, broadly ovate, cordate, rounded or truncate at base, rounded or acute at apex, coarsely serrate on margin, 4-7 inches long, dark green above, pale green below; leaf-stalks round.

LEAF-SCARS—Alternate, large, elevated, often 3-lobed, indented on upper margin; with 3 conspicuous bundle-scars.

FLOWERS—Appear in March or April. In general similar to the Cottonwood only both staminate and pistillate aments are shorter.

FRUIT—A drooping ament, when mature about 4-6 inches long, bearing a few, scattered, dark green, 3-4-valved capsules containing small seeds surrounded by a mat of white hairs.

WOOD—Same as that of the Cottonwood only slightly heavier. See description page. 99.

DISTINGUISHING CHARACTERISTICS—The Downy Poplar, also known as Swamp Cottonwood, Black Cottonwood, River Cottonwood, and Swamp Poplar, may be distinguished from all the Aspens, Poplars, and Cottonwoods native to this State by its round leaf-stalks. The leaf-stalks of all the others are laterally flattened. The leaves are large and more bluntly pointed than those of the other species. The leaf-margins are not so finely toothed as those of the American Aspen but finer than the other two native species. The bark on old trunks is light reddish-brown. The twigs are stouter than those of the Aspens and contain orange colored pith. The Aspens have white pith. The buds are bright reddish-brown, slightly resinous, covered with scales which are often pubescent near the base.

RANGE—Connecticut along coast to Georgia, west to Louisiana, and northward to Kentucky and Missouri. Its range suggests a somewhat contorted horseshoe.

DISTRIBUTION IN PENNSYLVANIA—Found only in the extreme southeastern and southern parts of the State. Reported from Chester, Delaware, and Franklin counties. Very rare and local.

HABITAT—Found only in low wet situations, and always mixed with other species in this State.

IMPORTANCE OF THE SPECIES—This species is too rare and local to be of any commercial importance. It is not attractive ornamentally on account of its heavy limbs and sparse, rounded crown. The wood is not listed separately on the market but bought and sold as **Cottonwood.**

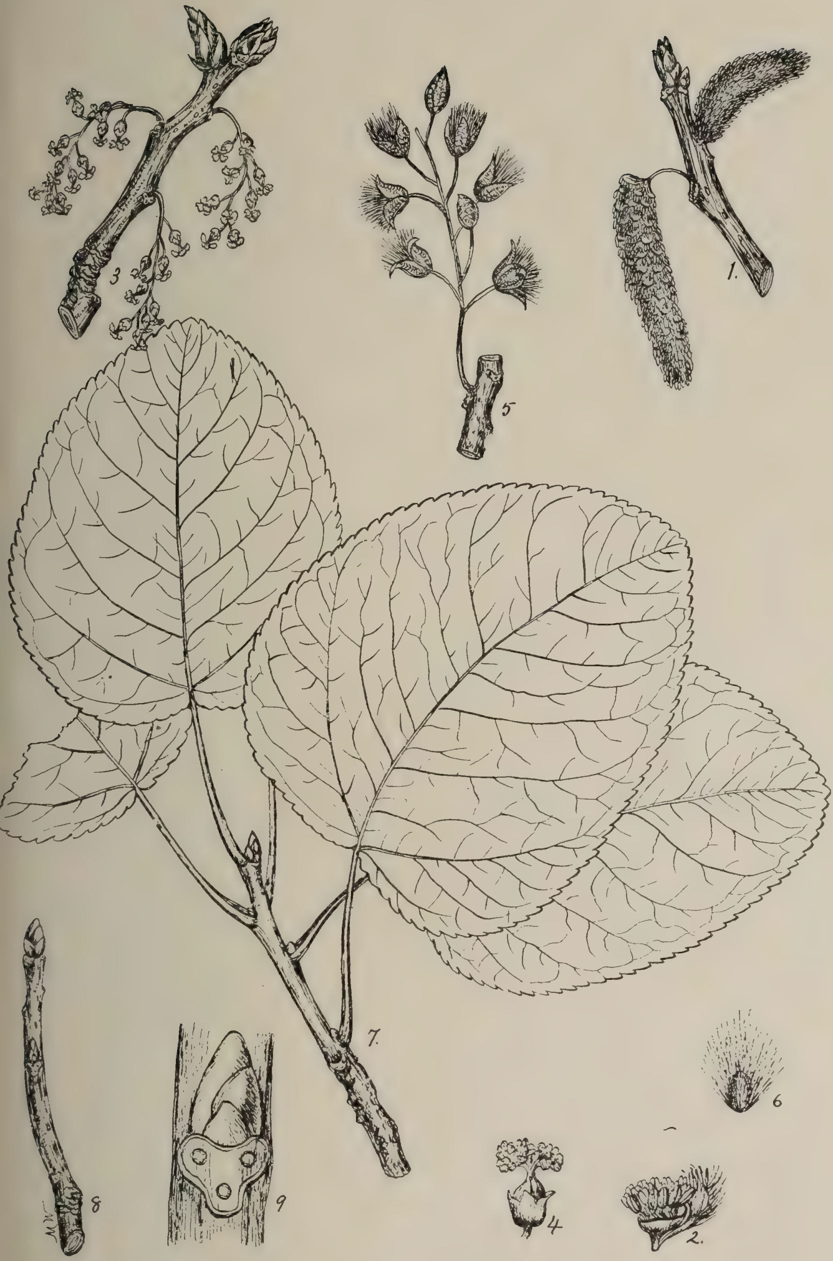

PLATE XXXIV. DOWNY POPLAR.

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. Section of a branch with a fruiting catkin and capsules, x ½.
6. A seed with hairs, enlarged.
7. A branch with mature foliage, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, enlarged.

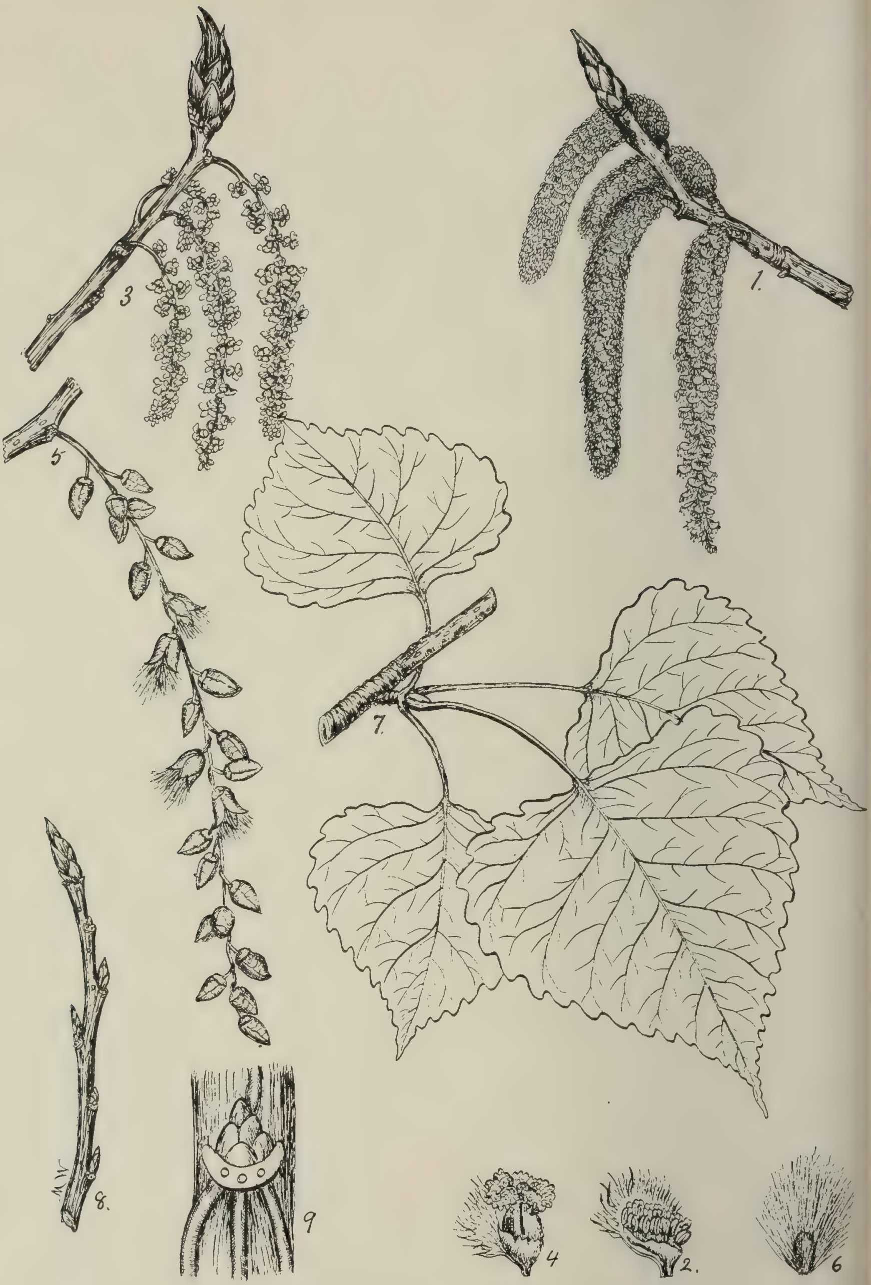

PLATE XXXV. COTTONWOOD.

1. A staminate flowering branch, x ½.
2. A staminate flower, enlarged.
3. A pistillate flowering branch, x ½.
4. A pistillate flower, enlarged.
5. Section of a branch with a fruiting catkin and capsules, x ½.
6. A seed with hairs, enlarged.
7. Section of a branch with mature foliage, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, enlarged.

COTTONWOOD.

Populus deltoides, Marshall.

FORM—A large tree usually 50-75 ft. high but may reach a height of more than 100 ft. with a diameter of 6 feet. Trunk tapering, continuous, sometimes clean for a considerable distance from the ground. Crown usually high and pyramidal. Lower lateral branches horizontal, while most of the upper branches are decidedly ascending.

BARK—On old trunks thick, ashy-gray, roughened by long deep furrows which are usually longitudinally parallel, and often connect with one another. Rather thin, smooth, and greenish-yellow on younger trunks.

TWIGS—Stout, usually yellow tinged with green or brown, round or ridged below the buds; covered with large, longitudinally-elongated lenticels; pith white and angular.

BUDS—Alternate, large, resinous, glossy, smooth, chestnut-brown, covered with numerous bud-scales which are sticky, resinous on the interior and smooth on the exterior. Terminal buds often 5-angled and larger than lateral ones; lateral buds usually divergent and often recurved.

LEAVES—Alternate, simple, broadly deltoid, truncate to wedge-shaped at base, acuminate at apex, coarsely serrate on margin, 3-5 inches long, thick, deep shining green above, pale green below. Leaf-stalks laterally flattened.

LEAF-SCARS—Alternate, large, lunate, elevated. depressed on upper margin, sometimes 3-lobed; with 3 bundle-scars. Stipule-scars dark and conspicuous.

FLOWERS—Appear about March or April. Staminate and pistillate flowers occur on different trees. The staminate are arranged in drooping aments 3-4 inches long and are densely flowered; the pistillate, in drooping aments 2½-3½ inches long and sparsely flowered.

FRUIT—A drooping ament bearing dark green, 3-4-valved capsules which contain small seeds surrounded with a mat of long white hairs. Fruiting aments longer than in the other native species, 8-12 inches.

WOOD—Diffuse-porous; with very indistinct rays; pores in early wood visible to unaided eyes; heartwood dark brown; sapwood wide and white; wood is soft, warps easily, and is difficult to split. Weighs about 23 lbs. per cubic foot. Used for paper pulp, boxes, crates, berry boxes, pails, and tubs.

DISTINGUISHING CHARACTERISTICS—The Cottonwood, also known as Carolina Poplar, Cotton Tree, and Whitewood may readily be distinguished at any season of the year by its lateral branches which have a tendency to ascend like the Lombardy Poplar (Fig. 36), and by its yellowish twigs which often have prominent ridges running down from the leaf-scars. The buds are larger, more resinous, and often more flattened than those of any other member of this genus; usually divergent and often incurved. The leaves are very characteristic since they have laterally flattened leaf-stalks, are deltoid in outline, truncate at the base and long-pointed at the apex. The pores in the early wood are visible to the unaided eye while those of the American and Large-toothed Aspens are not visible.

RANGE—Quebec and Ontario south to Florida, west to the Rocky Mountains.

DISTRIBUTION IN PENNSYLVANIA—Natural distribution is very limited. Reported from Presque Isle, Erie county and from Lancaster county. Locally escaped cultivation. Planted extensively for ornamental purposes and in a few plantations for forestry purposes.

HABITAT—Prefers rich moist soil, like banks of streams, borders of lakes, and semi-swamps.

IMPORTANCE OF THE SPECIES—The Cottonwood is planted extensively as an ornamental tree but as such it has few merits except its rapid growth, rather attractive form in winter, and the pleasant balsamic odor from its coated, young, developing leaves. It is well adapted to wet locations and may be planted where other more valuable trees will not grow. It grows rapidly, and produces an excellent pulp-wood. This tree is known to grow 5 feet in a single year and 40 feet in 10 years. Cuttings taken from trees and placed in the ground grow very readily. When planted in the streets its roots often lift pavements, and clog drains and sewers. Not adapted for street planting.

THE WALNUT FAMILY—JUGLANDACEAE.

This family comprises about 6 genera with 35 species of trees and shrubs found chiefly in the warmer portion of the north temperate zone. Two genera with about 19 species are native to North America. Both of these genera, Juglans and Carya, have representatives in Pennsylvania. The former genus has 2 species and the latter 5 species native to the State. In addition to the existing species a great number of fossil species have been referred to this family Thirty fossil species belonging to the genus Juglans and 10 species belonging to the genus Carya have been described.

This is one of the most important families of trees native to Pennsylvania. Both the Hickories and the Walnuts yield very valuable wood. The wood of the Walnuts is esteemed especially for cabinet work and that of the Hickories on account of its strength and flexibility. The bark and husks of the Walnuts are used sometimes as a dyestuff. The fruit of both genera is edible.

The staminate and pistillate flowers are separate but borne on the same tree and usually in the same branch. The staminate flowers are in long drooping aments while the pistillate appear as buds and occur in small few-flowered clusters. The leaves of both genera are compound and alternate. The fruit is a nut. The nut of the Walnuts is sculptured and covered with a fleshy, indehiscent, pulpy husk while the nut of the Hickories is not sculptured but covered with a dehiscent husk.

KEY TO THE GENERA.

Page

1. Pith of twigs chambered; nuts sculptured or rugose with indehiscent husk; staminate catkins thick, compact, usually sessile and solitary; wood diffuse-porous, ...Juglans 10

1. Pith of twigs continuous; nuts smooth or ridged with dehiscent husk; staminate catkins slender, loose, long-stalked, in 3s; wood ring-porous, ...Carya 10

THE WALNUTS—JUGLANS, L.

This genus comprises about 15 species which are found chiefly in the north temperate zone. Five species are native to North America, two of which are native to Pennsylvania. In addition to the native species a European species known as the English Walnut (Juglans regia L.) is widely distributed in the United States as an ornamental tree. It is this European species which yields the valuable Circassian Walnut wood used so extensively in the manufacture of furniture and it also produces the English walnuts so common on our markets.

Our native species produce materials which are of considerable commercial importance. The wood is highly prized. The nuts are delicious and valuable as a food. The bark and husks are used as dyes and tans. The wood of our species is diffuse-porous and brown to black in color. The leaves are alternate and compound. The pith is chambered. The fruit ripens in one season and consists of a sculptured or rugose nut covered by a pulpy husk which does not split open into regular segments. The kernel of the nut is 2-4 lobed, large and oily. The nuts are scattered mainly by rodents, which bury them for food, and by floods which carry them along their courses.

SUMMER KEY TO THE SPECIES.

Page.

1. Leaflets 11-17, often viscid-hairy, the terminal leaflet usually present; pith dark brown; bark gray; fruit sticky-hairy; nut elongated-ovate, ...J. cinerea 102

1. Leaflets 13-23, not viscid-hairy, the terminal leaflet often absent; pith light brown; bark dark brown; fruit not sticky-hairy; nut globose, ...J. nigra. 103

WINTER KEY TO THE SPECIES.

1. Bark gray; pith dark brown; nut elongated-ovate; upper surface of leaf-scar not notched; hairy transverse fringe above leaf-scar present; terminal buds evidently flattened, not less than ⅓ of an inch long, ...J. cinerea 102

1. Bark dark brown; pith light brown; nut globose; upper surface of leaf-scar notched; hairy fringe above leaf-scar absent; terminal buds slightly flattened, ⅓ of an inch or less in length, ...J. nigra 103

BUTTERNUT.

Juglans cinerea, Linnaeus.

FORM—A small to medium-sized tree usually attaining a height of 30-50 ft. with a diameter of 1-2 ft., but may reach a height of 80-100 ft. with a diameter of 3-4 feet. Trunk usualy short, like that of the apple tree. Crown usually broad, deep, round-topped, rather open, often unsymmetrical.

BARK—On branches and young trunks rather smooth, light gray; on older trunks roughened by black fissures which separate wide, smooth, light gray ridges. Inner bark bitter, light in color, becoming yellow on exposure. See Fig. 80.

TWIGS—Alternate, stout, round; at first hairy and sticky, later smooth; roughened by leaf-scars, bitter to taste, greenish-gray to buff in color, covered with a few pale lenticels; pith chambered, dark brown. If chewed, twigs and young bark color saliva yellow.

BUDS—Alternate, covered with dense pale down. Terminal bud ½-¾ of an inch long, flattened, blunt-pointed with its outer scales lobed. Lateral buds smaller than terminal, ovate, very blunt-pointed, often superposed. Scaly cone-like lateral buds often present. These are in reality partially developed catkins.

LEAVES—Alternate, compound, 15-30 inches long, with 11-17 leaflets. Leaflets 3-5 inches long, serrate on margin, acute at apex, unequally rounded at base and usually sessile or nearly so. Petioles hairy and sticky.

LEAF-SCARS—Alternate, large, 3-lobed, concave, with raised margins, with 3 clusters of bundle-scars arranged in a U-shaped line. Upper margin of leaf-scar usually convex, rarely notched.

FLOWERS—Appear about May when leaves are half developed. Staminate and pistillate flowers separate, but occur on the same tree and usually on the same branches. Staminate arranged in unbranched catkins, which become 3-5 inches long. Pistillate produced in 6-8-flowered spikes.

FRUIT—An elongated-ovate sculptured nut covered with a fleshy indehiscent husk. Husk very hairy and sticky. Nut four-ribbed, pointed at one end; contains a sweet edible and very oily kernel.

WOOD—Diffuse-porous with ring-porous tendency; with inconspicuous medullary rays; soft not strong, light brown, and coarse-grained. Weighs 25.46 lbs. per cubic foot. Used in furniture, interior finishings, and occasionally in church altars, ceiling, and flooring.

DISTINGUISHING CHARACTERISTICS—The Butternut, also known as White Walnut and Oilnut, resembles the Black Walnut, but is distinguished from it by its shorter and light-barked trunk, dark brown pith, larger and more flattened terminal buds, lighter colored wood, elongated-ovate fruit, unnotched upper margin of the leaf-scar with a hairy fringe above it.

RANGE—New Brunswick and Quebec, west to Minnesota, and south to Delaware and Arkansas, and along the mountains to Georgia.

DISTRIBUTION IN PENNSYLVANIA—Local throughout the State in rich bottomlands and on fertile hillsides. Very common locally in the southeastern and southern parts.

HABITAT—Prefers rich moist soil. Common along fences, streams, and roads. Occasionally found on high mountains.

IMPORTANCE OF THE SPECIES—The Butternut can hardly be classified as a valuable timber tree. It produces a beautiful wood and delicious nuts but the trees seldom reach a large size. The old trees are very susceptible to the attack of wood-destroying fungi. The tree is attractive ornamentally. It branches freely often forming many crooks and crotches which yield the highly figured wood.

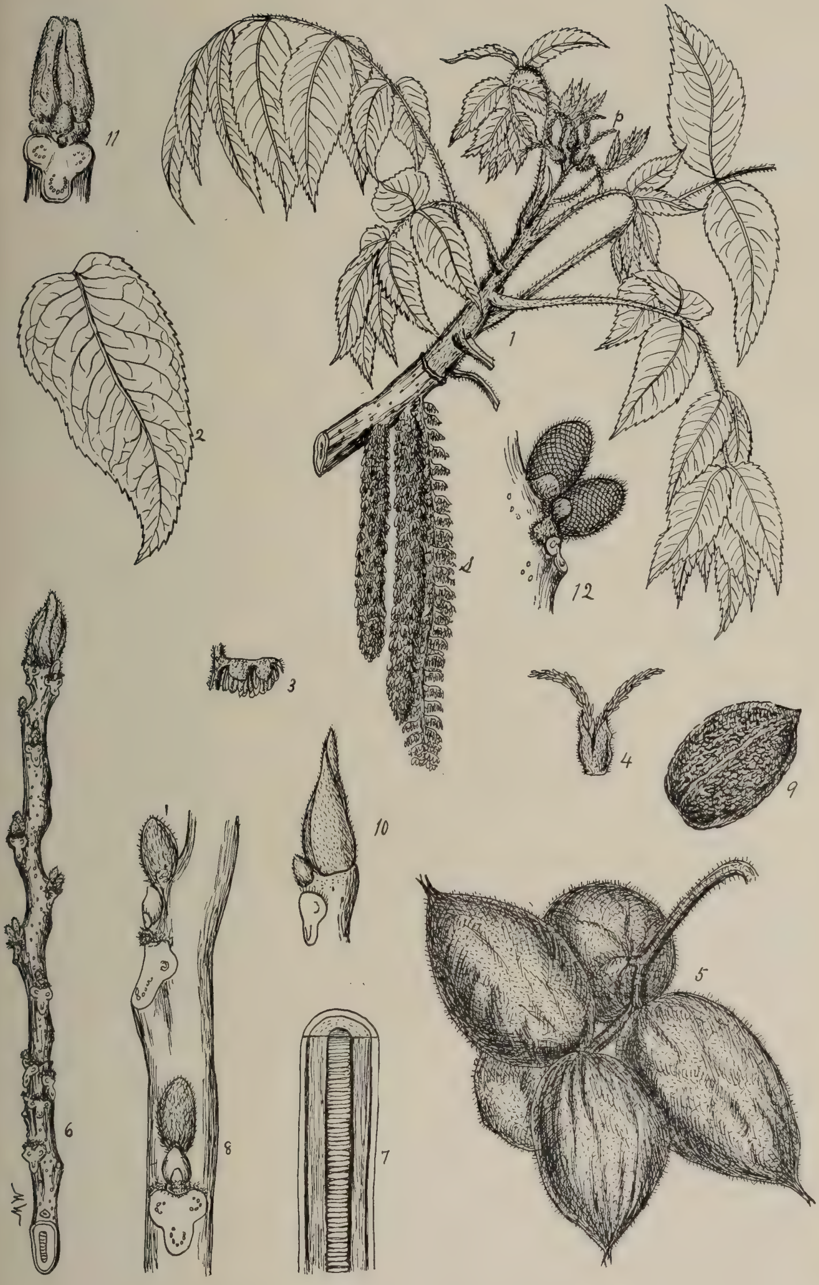

PLATE XXXVI. BUTTERNUT.

1. Branch with one-half developed leaves, (s) 3 unbranched catkins of staminate flowers, and (p) a cluster of pistillate flowers, x ½.
2. A mature leaflet, x ½.
3. A staminate flower, slightly enlarged.
4. A pistillate flower, slightly enlarged.
5. A cluster of mature fruit, x ½.
6. A winter twig showing buds, lenticels, leaf-scars, and pith, x ½.
7. Longitudinal section of twig showing chambered pith, slightly enlarged.
8. Section of winter branch showing leaf-scars, hairy fringe above leaf-scars and superposed buds, slightly enlarged.
9. A nut with husk removed, x ½.
10. A terminal bud, natural size.
11. A terminal bud (broad-side view), natural size.
12. Section of a branch showing superposed lateral flower buds, enlarged.

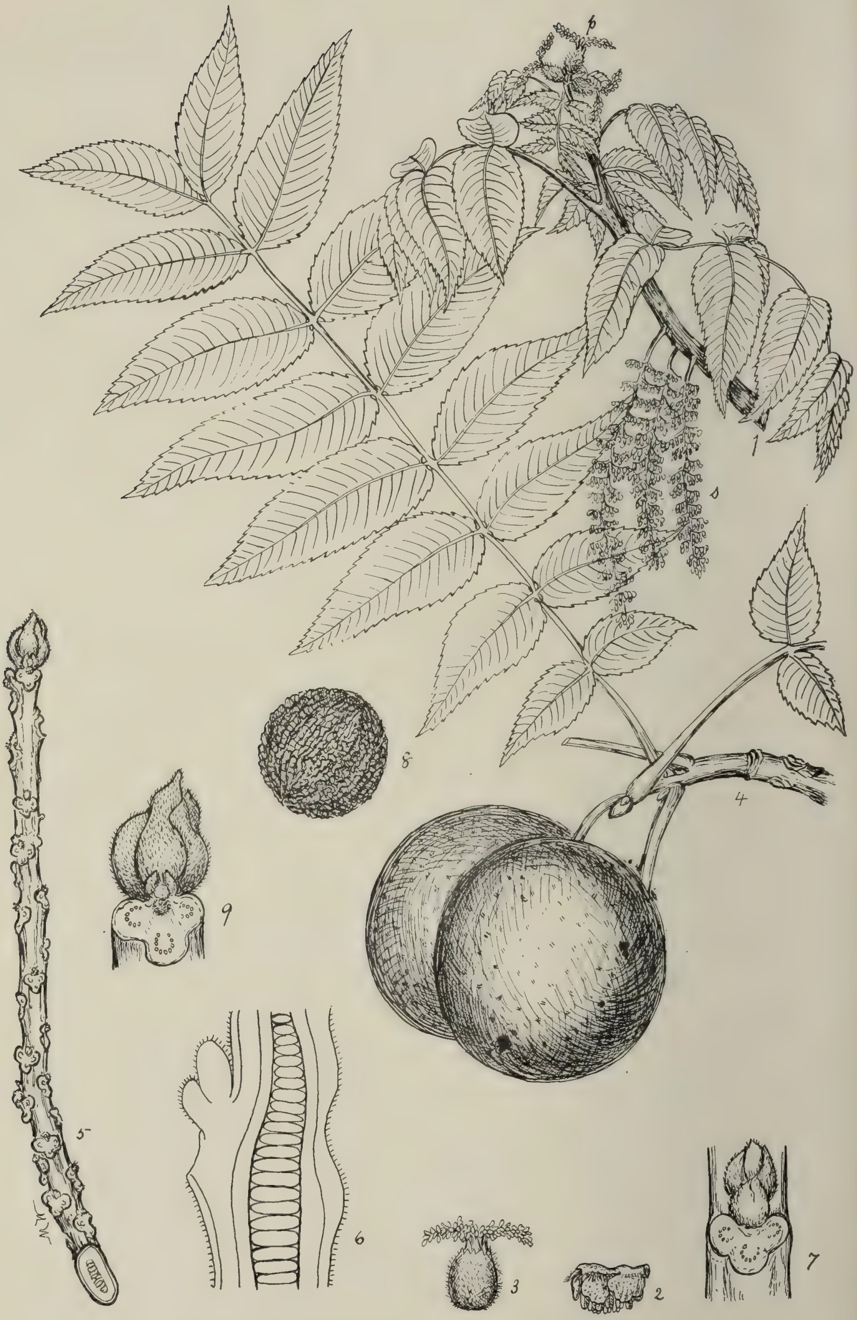

PLATE XXXVII. BLACK WALNUT.

1. Branch with developing leaves and (s) three solitary catkins of staminate flowers and (p) a spike with three pistillate flowers, x ½.
2. A staminate flower, slightly enlarged.
3. A pistillate flower, slightly enlarged.
4. A branch with a mature leaf and fruit, x ½.
5. A winter twig, x ½.
6. Longitudinal section of twig showing chambered pith, enlarged.
7. Section of twig showing superposed and gaping buds, and leaf-scars with 3 clusters of bundle-scars and notched upper surface, slightly enlarged.
8. A nut with husk removed, x ½.
9. Terminal section of winter twig showing leaf-scar and terminal bud with bud-scales, slightly enlarged.

BLACK WALNUT.

Juglans nigra, Linnaeus.

FORM—A large tree, usually attaining a height of 80-100 ft. with a diameter of 2-3 ft., but may reach a height of 150 ft. with a diameter of 6-8 feet. Trunk usually straight, clean, slightly tapering, bearing a round-topped crown.

BARK—Semi-fibrous, thick, rough, longitudinally and occasionally diagonally fissured. Outer bark dark brown to grayish-black. Inner bark light, but turns yellow upon exposure. See Fig. 81.

TWIGS—At first hairy, later smooth, orange-brown to dark brown, stout, covered with rather inconspicuous, somewhate raised lenticels; pith light brown, chambered.

BUDS—Alternate, covered with thick, pubescent scales. Terminal buds usually less than ⅓ of an inch long, flattened, ovate, blunt-pointed. Lateral buds usually less than 1/6 of an inch long, obtuse at apex, often superposed.

LEAVES—Alternate, compound with 13-23 leaflets. Leaflets 3-4 inches long, oblique at base, acute at apex, serrate on margin, almost sessile and arranged opposite or alternate to each other.

LEAF-SCARS—Alternate, large, 3-lobed, often heart-shaped, raised; upper margin notched in which an axillary bud is often located. Bundle-scars grouped in three clusters, arranged in a U-shaped line.

FLOWERS—Appear in May when the leaves are about half developed. Staminate and pistillate flowers separate, but occur on same tree and usually on same branch. Staminate arranged in unbranched catkins. Pistillate produced in 2-5-flowered spikes.

FRUIT—A sculptured nut with a fleshy indehiscent covering. Nut round, very rough, 1-2 inches in diameter, occurs solitary, in pairs, sometimes in 3s; contains an edible somewhat oily kernel.

WOOD—Diffuse-porous with a ring-porous tendency; medullary rays inconspicuous; rich dark brown, very durable, hard, strong, splits easily, takes glue well. Weighs 38.11 lbs. per cubic foot. Used in furniture, interior finishings, musical instruments, automobiles, sewing machines, fire-arms.

DISTINGUISHING CHARACTERISTICS—The Black Walnut, also known as Walnut, somewhat resembles the Butternut or White Walnut but bears little resemblance to other trees. It may be distinguished from the Butternut by its light brown chambered pith, shorter and less flattened terminal buds, darker bark, larger size, more globose nut, notched upper margins of leaf-scars, and the absence of a hairy fringe above the leaf-scar.

RANGE—New England and New York to Minnesota, and south to Florida.

DISTRIBUTION IN PENNSYLVANIA—Local throughout the State in rich bottomlands and on fertile hillsides.

HABITAT—Prefers rich moist soil. Requires plenty of light and deep soil since it is evidently tap-rooted.

IMPORTANCE OF THE SPECIES—The Black Walnut is one of the most valuable timber trees native to this State. It reaches a large size, is attractive ornamentally, and produces wood valuable for its color, figure, and the fine polish which it takes. The nuts are highly prized. Forest grown trees rarely produce much fruit. Open grown trees produce abundant fruit and often highly figured wood.

THE HICKORIES—CARYA, Nuttall.

The Hickories and the Walnuts belong to the same family. All species of Hickory, so far as known, are native to the part of North America lying east of the Rocky Mountains. Geological records inform us that the ancient forests of hickory extended into Greenland and Europe. None of the fossil species shows evidence of living after the ice age. This suggests the presumption that the hickory forests were completely destroyed by sheets of ice advancing from the North towards the South. These sheets covered a large part of Europe and North America. To-day no native species of Hickory are found in Europe, showing that they were completely exterminated during the ice age. In North America the ice covered only a portion of the range of hickory. Hickory is found today not only in the non-glaciated region of North America but in addition it has regained some of the lost territory. The northern limit of Hickory is, however, still about 1,000 miles south of its northern limit in the ancient flora of Greenland. The range of some of the more important species of Hickory has been extended by man.

The Hickories have alternate, compound and odd-pinnate leaves. The leaf-scars are large and conspicuous. The flowers are unisexual. The staminate or male (pollen-bearing) flowers are produced in long slender, drooping aments. The aments are usually in 3s, united near the base of twig into a common stalk which is attached to the twig at the base of the new growth. The pistillate or female flowers which develop into the fruit occur at the end of the season's twigs in spike-like clusters of 2-6. The fruit resulting from the development of the pistillate flowers matures in one season. The nuts are ovoid to cylindrical and covered with a husk which is 4-valved. In most species the husk splits open at least to the middle when it becomes dry but in a few species it separates very little.

The Hickories are amongst our most important timber trees. They are not important because they produce a large quantity of wood but because they produce a special quality of wood used for special purposes for which no substitutes have been found. The wood is unsurpassed for such uses where strength combined with lightness is desired. It is largely used for handles and in the manufacture of our best carriages, especially in the construction of the wheels. Not all of the species, however, produce valuable wood. The wood of the Bitter Nut Hickory is relatively of little value. The nuts of a few species are edible. These nuts were used for food and for oil by the Indians and at the present time they are used extensively for food. The most valuable and edible nuts are obtained from the Shag-bark Hickory (Carya ovata).

This genus comprises about 10 species found in eastern North America and 1 species in Mexico. Six species are native to this State. One species, the small-fruited Hickory (Carya microcarpa, Nutt.), sometimes considered a variety of the Pignut Hickory, is found locally in the State but not described in this publication. In addition to our native species the Pecan Hickory (Carya illinoensis) is planted extensively for ornamental purposes and for the sweet nuts which it produces.

SUMMER KEY TO THE SPECIES.

Page.

1. Leaflets 7-11, small, lanceolate, usually curved, ...**C. cordiformis** 110
1. Leaflets 5-7, larger, broader than lanceolate, rarely curved, ...2

2. Husk of fruit splits tardily into 4 valves; valves of fruit thin and rather friable at maturity; twigs smooth, relatively slender, cherry-colored to gray, ...**C. glabra** 109
2. Husk of fruit splits promptly into 4 valves; valves of fruit thick and hard at maturity; twigs often hairy towards tip, rather stout, buff, gray, or brownish,......3

3. Bark close, rough but not shaggy on old trunks; twigs relatively stout; foliage scurfy or pubescent, ...**C. alba** 108
3. Bark shaggy separating into long plates on old trunks; twigs not so stout; foliage smooth or sometimes downy beneath, ...4

4. Leaflets usually 7; nuts dull white or yellowish and pointed at both ends, **C. laciniosa** 107
4. Leaflets usually 5; nuts white, rounded or notched at the base, ...**C. ovata** 106

WINTER KEY TO THE SPECIES.

1. Buds yellow with 4-6 bud-scales valvate in pairs; lateral buds often evidently-stalked; terminal buds elongated and flattened, ... **C. cordiformis** 110
1. Buds not yellow, truly scaly; bud-scales 10 or more usually overlapping, except outer ones on lateral buds which may form a closed sac but in time split from the top; inner scales hairy, ...2

2. Buds small; terminal buds 1/5 to 2/5 of an inch long, their outer scales glandular dotted; twigs smooth, relatively slender, cherry-colored to gray; husk of fruit thin, not freely splitting to base, with thin-shelled nut, ...**C. glabra** 109
2. Buds large; terminal buds 2/5 to 3/5 of an inch long, their outer scales almost glandless; twigs often hairy towards tip, rather stout, buff, gray, or brownish; husk of fruit thick, freely splitting to base, ...3

3. Twigs relatively stout; bark rough and close, not shaggy; nut brownish, thick-shelled, with small kernel; terminal buds broadly-ovate with their outer scales early deciduous, ...**C. alba** 108
3. Twigs not so stout; bark shaggy; nut white, dull-white, or yellowish with large kernel; terminal buds elongate-ovate with their outer scales tardily deciduous,....4

4. Nuts dull white or yellowish and pointed at both ends, ...**C. laciniosa** 107
4. Nuts white, rounded or notched at the base, ... **C. ovata** 106

SHELL-BARK HICKORY.

Carya ovata, (Miller) K. Koch.

FORM—A large tree usually reaching a height of 50-75 ft. with a diameter of 2 ft. but may reach a height of 120 ft. with a diameter of 3-4 feet. Trunk straight, slender, in dense stands free from branches for the greater part of its length; in open grown trees short, with an oblong-cylindrical high crown.

BARK—On old trunks shaggy, light gray, 2/5-1 inch thick, peeling off in rough strips or plates which are usually loose at both ends and fastened in the middle. On young trunks smooth and light gray. See Fig. 88.

TWIGS—Intermediate in thickness between the Mocker Nut and the Pignut Hickory, usually slightly downy, sometimes smooth and glossy; reddish-brown to grayish, covered with numerous conspicuous and longitudinally-elongated lenticels; pith angular.

BUDS—Alternate, more than 2-ranked. Terminal bud broadly ovate, blunt-pointed, 2/5-4/5 of an inch long, usually covered by about 10 bud-scales. The 3-4 outer scales dark brown, broadly triangular, sharp-pointed, often hairy especially along margin, sometimes smooth, and often with the apex terminating in a long rigid point. Inner scales increase in size in spring, are tardily deciduous, yellowish-green or reddish, densely downy on outer surface and smooth within.

LEAVES—Alternate, compound, with 5-7 leaflets, 8-14 inches long. Leaflets differ in size; basal pair small, relatively short and widest near the base; upper pair obovate and larger than basal pair; terminal large and obovate. Leaflets serrate on margin, acute at apex, tapering or rounded at base, usually smooth but sometimes hairy on lower surface.

LEAF-SCARS—Alternate, more than 2-ranked, large, conspicuous, somewhat raised, heart-shaped or 3-lobed or inversely-triangular or sometimes elliptical, containing numerous conspicuous bundle-scars which are distributed irregularly or grouped in 3 clusters or arranged in a curved line.

FLOWERS—Appear about May when leaves are almost fully developed. Staminate and pistillate flowers occur separately. Staminate hairy and arranged in aments which are clustered in 3s and 4-5 inches long. Pistillate rusty-woolly arranged in 2-5 large spikes.

FRUIT—Globular or depressed at apex, 1-2 inches long, with a thick husk which splits into four pieces completely to the base. Nut white, oblong, somewhat flattened, ridged, barely tipped with a point, with thin shell and large sweet kernel.

WOOD—Ring-porous; pores of summer wood rather large, isolated, rather evenly distributed, not in groups or lines; medullary rays rather abundant but inconspicuous; conspicuous lines of wood parenchyma present. Wood very heavy, hard, strong, tough, elastic, close-grained, usually straight-grained, not durable in contact with soil. Heartwood light brown or reddish with white sapwood. Weighs from 50 to 52 lbs. per cubic foot. Used chiefly for handles and light vehicles. Valuable for fuel and smoking meat.

DISTINGUISHING CHARACTERISTICS—The Shell-bark Hickory, also known as Shag-bark Hickory, can be distinguished from the Bitter Nut Hickory by means of its larger many-scaled buds which are not flattened nor yellow, and by its bark which is shaggy, while that of the latter is close and rough. The bark of the Pignut Hickory, is also close and rough. The Pignut Hickory has scaly buds but they are much smaller than those of the Shell-bark Hickory. The fruit of both the Pignut Hickory and Bitter Nut Hickory is smaller and has a thin tardily or non-splitting husk and a small bitter kernel, and their leaves are smoother and their leaflets narrower than those of the Shell-bark Hickories. The Mocker Nut Hickory has stouter twigs, scurfier pubescent foliage, closer and rougher bark, and browner nuts with a small kernel. For distinguishing characteristics between Carya ovata and Carya laciniosa, see page 107.

RANGE—Quebec west to Minnesota and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Most common in the southeastern and southwestern parts of the State. Rare in the mountainous parts, except locally in the valleys. Rather abundant locally east of the Allegheny mountains especially in the fertile valleys and along the rich foothills. Reported rather abundant locally in the northern part.

HABITAT—Prefers rich moist soil and plenty of light. Common in the valley and in moist hillside woods. Also common along streams, and on the border of swamps.

IMPORTANCE OF THE SPECIES—This is a very important species on account of the valuable wood and nuts which it produces. It is not very common in the State as a whole, but where it does occur it should be protected and regenerated as much as possible. Seeds should be planted rather than seedlings because the latter are sensitive to transplanting on account of their long taproot.

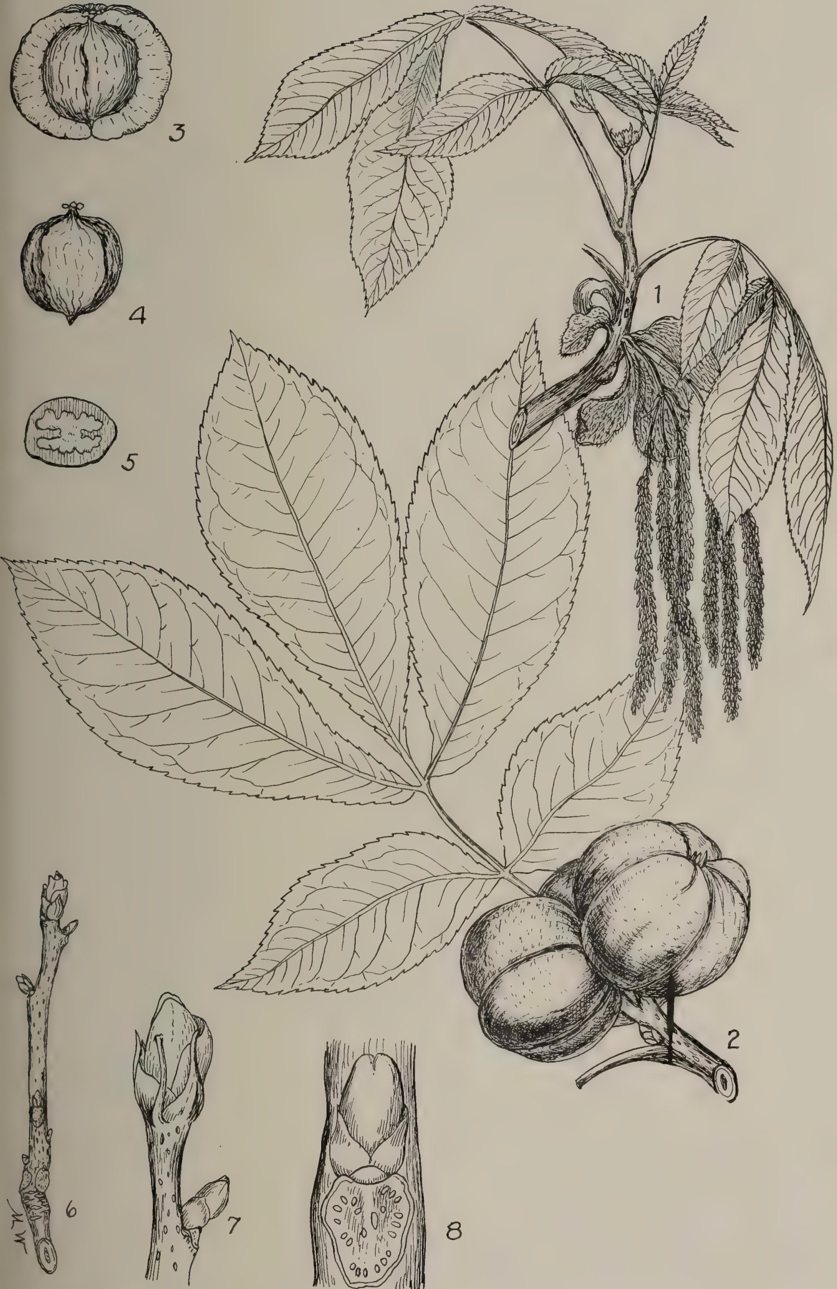

PLATE XXXVIII. SHELL-BARK HICKORY.

1. A flowering branch, x ½.
2. A branch with fruit and a mature leaf, x ½.
3. A nut with part of husk removed, x ½.
4. A nut, x ½.
5. Cross-section of a nut showing kernel, x ½.
6. A winter twig, x ½.
7. Terminal part of a winter twig, natural size.
8. Section of a winter twig showing a lateral bud and leaf-scar, enlarged.

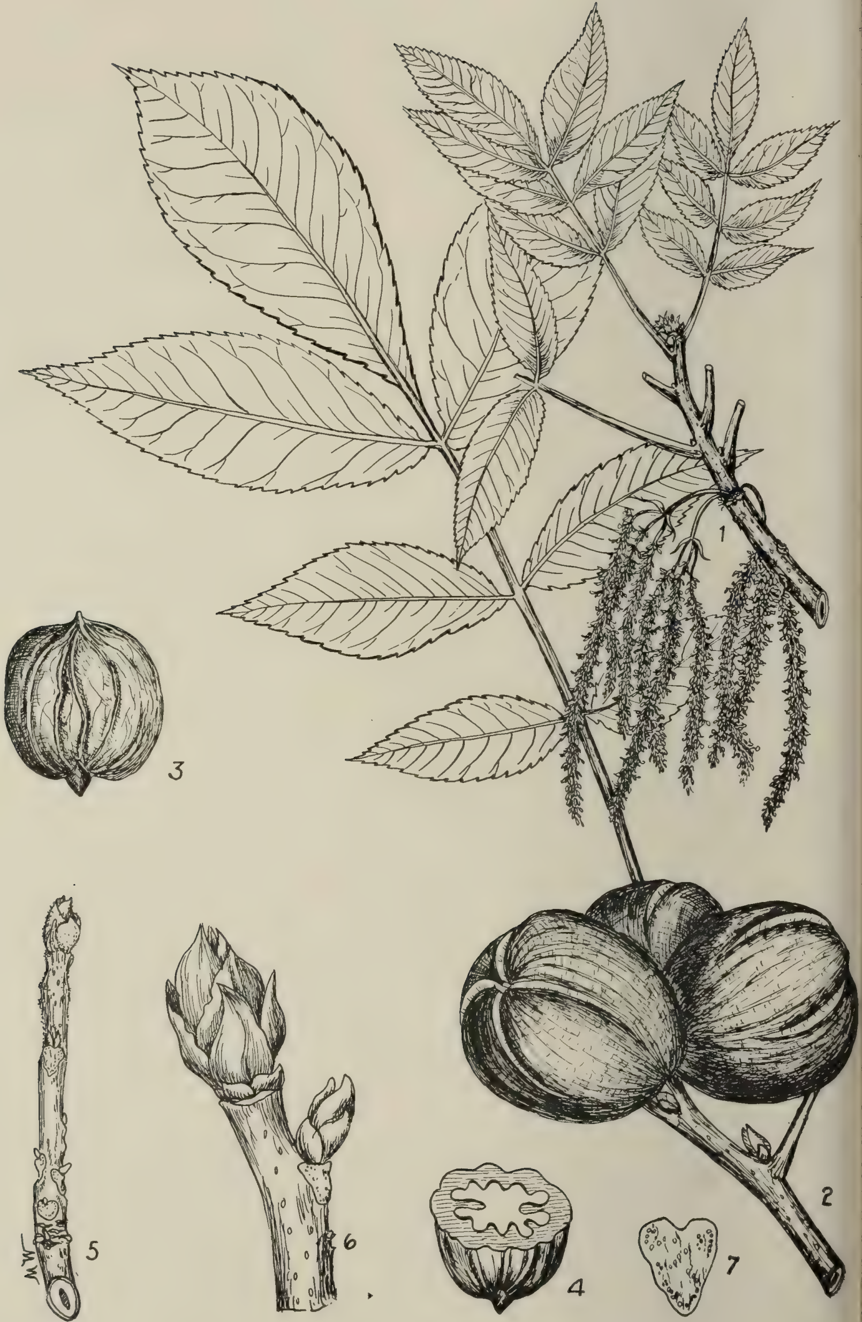

PLATE XXXIX. BIG SHELL-BARK HICKORY.

1. A flowering branch, x ½.
2. A branch with fruit and a mature leaf, x ½.
3. A nut, x ½.
4. Cross-section of a nut, x ½.
5. A winter twig, x ½.
6. Terminal part of a winter twig, slightly enlarged.
7. A leaf-scar with bundle-scars, slightly enlarged.

BIG SHELL-BARK HICKORY.

Carya laciniosa, (Michaux f.) Loudon.

FORM—In general it is the same as the Shell-bark (Carya ovata) except that it does not attain so large a diameter. When grown in a dense forest its trunk is very long, clean, and slightly tapering.

BARK—Same as Shell-bark Hickory (Carya ovata) or probably somewhat less shaggy.

TWIGS—Stout, usually a little velvety or tomentose, buff to nearly orange in color, covered with numerous rather inconspicuous longitudinally-elongated lenticels; pith angular.

BUDS—Similar to those of the shell-bark (Carya ovata) except that they are a little larger and have less keeled and more hairy outer scales.

LEAVES—Alternate, compound, with 7-9 leaflets, 10-22 inches long. Leaflets differ in size; basal pair smallest, about ½ size of the terminal; the upper pair broadest between the middle and the apex. Leaflets sharp-pointed at apex, serrate on margin, tapering or rounded at base, thick, firm, dark green and smooth above, pale green to brownish and hairy below. Leaf-stalks grooved, stout, smooth or hairy, thickened at base, often persist for a long time.

LEAF-SCARS—Alternate, more than 2-ranked, large, conspicuous, somewhat raised, heart-shaped or 3-lobed or inversely triangular or sometimes elliptical, containing numerous conspicuous bundle-scars which are distributed irregularly, grouped in 3 clusters or arranged in a curved line.

FLOWERS—Similar to those of Shell-bark Hickory (Carya ovata). See page 106.

FRUIT—Ovoid or broadly-oblong, 4-ribbed above the middle, covered with very thick husk which splits readily to the base. Nut dull white or yellowish, thick-walled, usually strongly pointed at both ends, containing a sweet, light brown and deeply lobed kernel.

WOOD—Similar to that of the Shell-bark (Carya ovata), see page 106. Lumbermen do not and manufacturers cannot distinguish between the wood of the two species.

DISTINGUISHING CHARACTERISTICS—The Big Shell-bark Hickory, also known as Shag-bark Hickory and King Nut, is most closely related to the Shell-bark Hickory (Carya ovata). It can best be distinguished by its dull white or yellowish nuts which are usually strongly pointed at both ends, while those of the latter are white and barely tipped with a point and often rounded or notched at the base. The leaflets of this species number 7-9 to a leaf and are more downy on the lower surface than in Carya ovata which has only 5-7 leaflets to each leaf. For distinguishing characteristics between this species and other Hickories see "Distinguishing Characteristics" under Carya ovata, page 106.

RANGE—Central New York and Pennsylvania west to Iowa and Nebraska and south to Tennessee and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Common in the southeastern part of the State. Most common east of the Allegheny mountains. Rare in the mountainous region except locally in the fertile valley between the mountains. Locally present in the western part. Probably most common in Northampton, Bucks and Montgomery counties.

HABITAT—Prefers wet, rich soil. Often found on situations which are temporarily flooded in spring. Frequent in rich bottomlands and on fertile hillsides.

IMPORTANCE OF THE SPECIES—This is a very important species on account of the valuable wood and nuts which it produces. It is not very common in the State as a whole, but where it does occur it should be protected and regenerated as much as possible. Seeds should be planted rather than seedlings because the latter are sensitive to transplanting on account of their long taproot.

MOCKER NUT HICKORY.

Carya alba, (Linnaeus) K. Koch.

FORM—A large tree usually 50-75 ft. high with a diameter of about 2 ft. but may reach a height of 90 ft. with a diameter of 3 ft. Crown narrow oblong to broad round-topped. Trunk often swollen at base, in dense stands straight, clean, with little taper and free from branches for one-half of its height.

BARK—Dark or light gray, ½-¾ of an inch thick, close, not shaggy nor smooth, roughened by irregular furrows which separate broad, flat, close, more or less scaly and rounded ridges. See Fig. 90.

TWIGS—Compared with the other Hickories very stout, usually decidedly downy, reddish-brown, covered with numerous pale and longitudinally-elongated lenticels; pith angular.

BUDS—Alternate, more than 2-ranked. Terminal bud very large, ovate, 2/5-4/5 of an inch long, densely hairy, usually blunt-pointed, covered with overlapping scales, the outer pair of which drops off in autumn and exposes the inner yellowish-gray silky scales. Lateral buds reddish-brown and do not split open very early.

LEAVES—Alternate, compound with 7-9 leaflets, 8-12 inches long. Leaflets lanceolate-obovate, sharp-pointed at apex, toothed on margin, rounded or tapering at base, very fragrant, often downy on lower surface. Leaf-stalks hairy, flattened, grooved, and enlarged at base. Upper pair of leaflets largest with greatest width between the middle and the apex; lower pair often oblong-lanceolate.

LEAF-SCARS—Similar to those of Shell-bark Hickory (Carya ovata).

FLOWERS—Appear about May when the leaves are half developed. Staminate and pistillate flowers separate. Staminate borne in slender catkins 4-5 inches long, which are clustered in 3s on a common stalk. Pistillate borne in 2-5-flowered pale hairy spikes.

FRUIT—Globular or ovoid, 1½-2½ inches long, with a very thick or hard husk which splits to the middle or base. Nut globular, brownish, not evidently-flattened but 4-ridged towards apex, with a very thick shell and comparatively small and sweet kernel.

WOOD—Similar to that of the Shell-bark Hickory (Carya ovata). See description page 106. Has a somewhat wider sapwood which is very white in color whence its specific name—alba. Heartwood dark brown.

DISTINGUISHING CHARACTERISTICS—The Mocker Nut Hickory, also known as the Big Bud Hickory and the White-heart Hickory, can be distinguished from the two species of Shell-bark Hickory by its bark, which is rough and close and does not shag off, its stouter twigs, its scurfy pubescent foliage and its globular fruit which contains a globular brownish thick-shelled nut with a relatively small kernel. The buds are somewhat larger than those of the Shell-bark Hickories and thicker than the Pignut and Bitter Nut. The kernel of the latter two species is bitterer and their leaflets are narrower and smoother.

RANGE—Massachusetts and Ontario, west to Nebraska, and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found most commonly in the rich valleys in the eastern and southern parts of the State with local outposts in the central part. Also found in the hardwood forest region in the western part.

HABITAT—Prefers rich, moist woods. Requires considerable moisture and sunlight. Does not thrive in shaded situations. Found mainly in valleys and in fertile situations at the bottom of slopes.

IMPORTANCE OF THE SPECIES—This species produces as valuable a wood as any of the Hickories. Some think that the wood is better than that produced by our other native Hickories because of the large amount of white sapwood. It is difficult to transplant on account of its long taproot, hence it is advisable to plant the seeds rather than seedlings. Every effort which one puts forth in developing and perpetuating this species in our forests, especially in the farmer's woodlot, is justified. The fruit is large but the kernel is small and as a consequence it has no special market value.

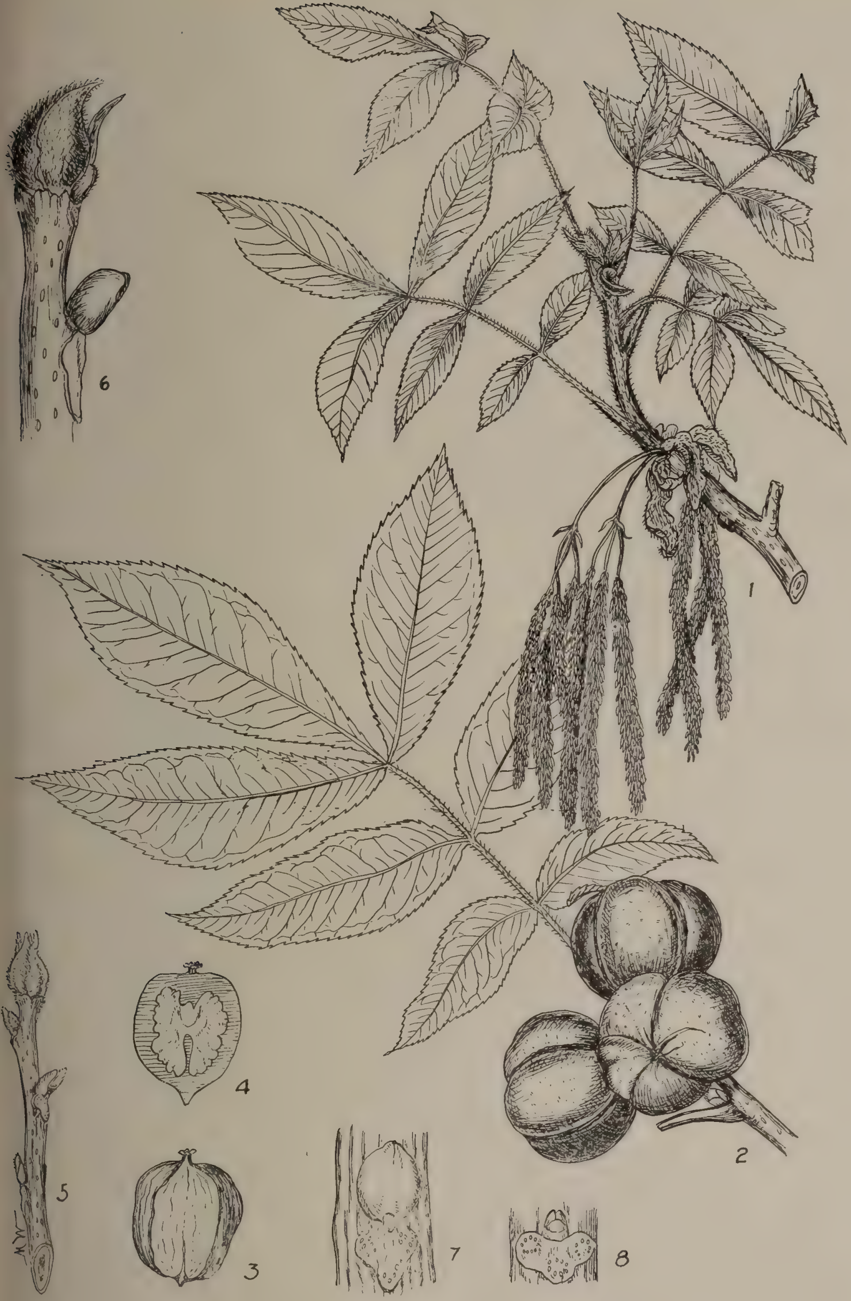

PLATE XL. MOCKER NUT HICKORY.

1. Branch with immature leaves and flowers, x ½.
2. Branch with a mature leaf and fruit, x ½.
3. A nut with husk removed, x ½.
4. Longitudinal section of a nut, x ½.
5. A winter branchlet, x ½.
6. A winter branchlet, slightly enlarged.
7. Section of winter branch, enlarged.
8. Section of winter branch, enlarged.

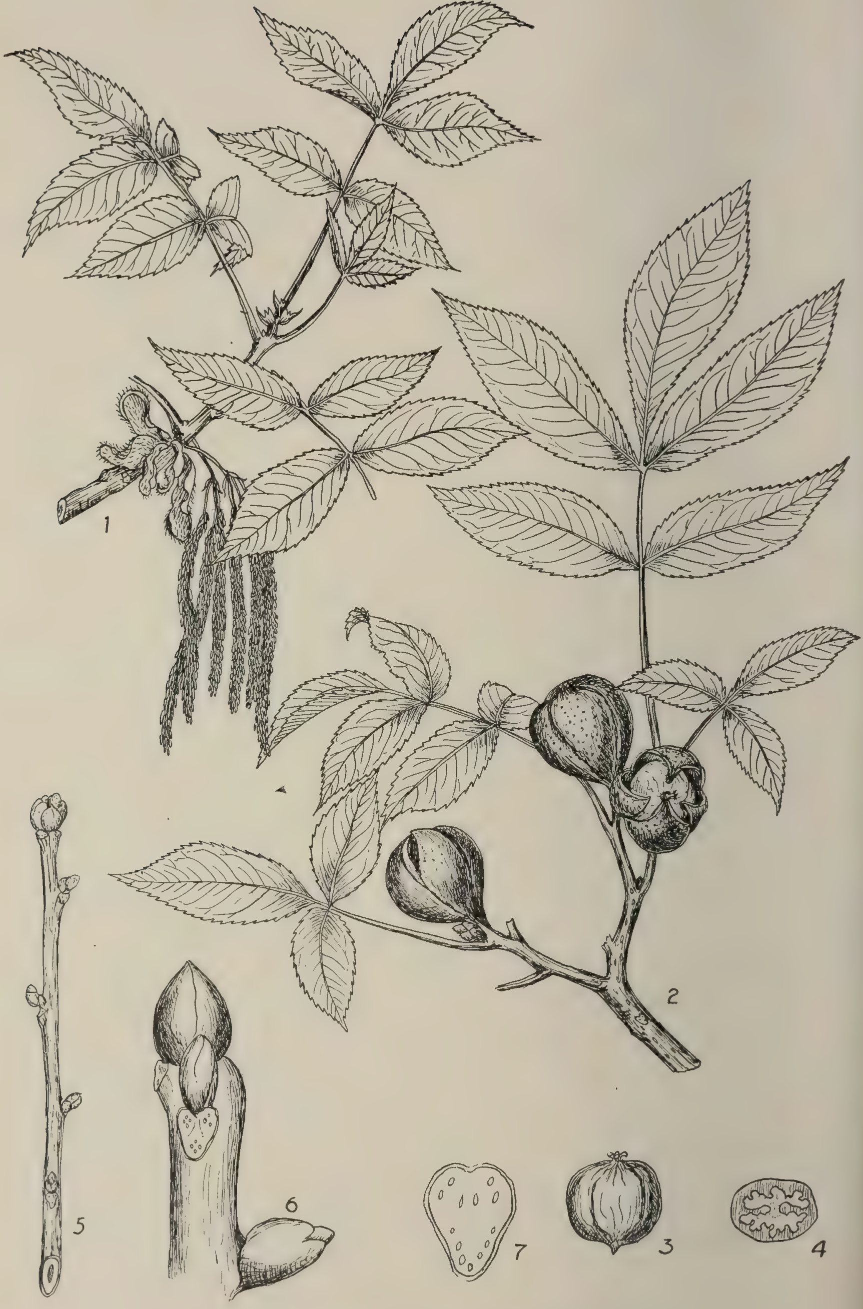

PLATE XLI. PIGNUT HICKORY.

1. Branch with immature leaves and flowers, x ½.
2. Branch with mature leaves and fruit with husk partly removed, x ½.
3. A nut with husk removed, x ½.
4. Cross-section of a nut, x ½.
5. A winter branch, x ½.
6. Terminal section of a winter branch, enlarged.
7. A leaf-scar with bundle-scars, enlarged.

PIGNUT HICKORY.

Carya glabra, (Miller) Spach.

FORM—A fair-sized tree usually 50-60 ft. in height with a diameter of 2-3 ft., but may reach a height of 90 ft. with a diameter of 3-4 ft. Trunk slender, slightly-tapering, often clean and long. Crown oblong in shape, rather narrow, sometimes high, formed by short, spreading branches, the lower ones often drooping.

BARK—Rarely peels off or exfoliates, is close, dark gray, shallowly-fissured, narrowly ridged, tough, ½-¾ of an inch thick. Resembles the bark of the White Ash. See Fig. 89.

TWIGS—Rather slender, usually smooth, at first yellowish-green, later reddish-brown, covered with numerous pale longitudinally-elongated lenticels, roughened by leaf-scars and bud-scale scars; pith angular.

BUDS—Alternate, more than 2-ranked, reddish-brown to gray, oval, blunt-pointed. Terminal bud ¼-½ of an inch long, larger than the laterals. All buds covered with reddish-brown, smooth, sharp-pointed, somewhat keeled outer scales and pale-silky inner scales. Outer scales often drop off during winter.

LEAVES—Alternate, compound, with 5-7 leaflets, 8-12 inches long. Leaflets oblong to obovate-lanceolate, sharp-pointed at apex, finely toothed on margin, tapering or obliquely rounded at base, thick, smooth, dark green above, paler below.

LEAF-SCARS—Alternate, heart-shaped or oblong or inversely triangular or 3-lobed, containing numerous prominent bundle-scars irregularly scattered or arranged in a curved line or in 3 clusters.

FLOWERS—Appear about May when leaves are about half developed. Staminate and pistillate flowers occur separately. Staminate in aments about 3-5 inches long and clustered in 3s on a common stalk. Pistillate in 2-5-flowered spikes on the new growth.

FRUIT—Matures about October, variable in shape and size, pear-shaped or spherical to obovoid, 1-2 inches long, tapering at the base, reddish-brown, sometimes pubescent. Husk may remain closed or split open from apex towards the middle or occasionally along the entire length. Nut oblong to oval, with thick bony shell containing a kernel which is at first sweet, later bitter.

WOOD—Similar to that of the other Hickories of the State, except the Bitter Nut Hickory. See description of wood page 106.

DISTINGUISHING CHARACTERISTICS—The Pignut or Broom Hickory, also known as the Bitter Nut Hickory, can be distinguished by its smooth and rather slender twigs which bear small oval reddish-brown buds covered with scales, the outer hair of which is smooth or glandular dotted and often falls off before spring, thus exposing the inner velvety scales. Its buds are not yellow like those of the Bitter Nut Hickory and smaller than those of the other species of our native Hickories. The pear-shaped to ovoid fruit, with a thick bony-shelled nut is characteristic. The bark is close and does not exfoliate like that of the Shag-bark Hickory. The leaves, with 5-7 usually smooth and oblong to obovate-lanceolate leaflets, are distinctive.

RANGE—Maine and Ontario west to Minnesota and Nebraska, and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the southeastern and southwestern parts. Also found locally elsewhere. More common in the mountainous portion of the State than any other Hickory.

HABITAT—Most common on dry ridges and hillsides. Rarer in swampy situations. Commonly scattered amidst our Oaks and Chestnut. Prefers plenty of sunlight.

IMPORTANCE OF THE SPECIES—The Pignut Hickory produces a very valuable wood, especially for the farmer. The fruit is not edible. It should be grown in the farmer's woodlot and in our larger forests in mixture with other species. The seedlings are difficult to transplant on account of their long taproots, which are rather sensitive. In attempting to grow this species, one should plant the nuts and not the seedlings. The great value of its wood justifies every effort that one can put forth in growing it.

BITTER NUT HICKORY.

Carya cordiformis, (Wangenheim) K. Koch.

FORM—A rather large tree usually 50-75 ft. high with a diameter of 1-2 ft. but may reach a height of 100 ft. with a diameter of 2½-3 feet. Trunk long, clean, with little taper. Crown round-topped, broadest near top, rather shallow in forest grown specimens. Lateral branches stout and ascending, often with semi-pendulous branchlets.

BARK—Light gray, rather thin, roughened by shallow fissures and narrow ridges; tight-fitting and does not peel off or shag off in loose scales like the Shag-bark Hickory. See Fig. 91.

TWIGS—Slender, smooth, glossy, often yellow-glandular and hairy towards apex, grayish or orange-brown or reddish, roughened with numerous pale and longitudinally-elongated lenticels; pith brown, angular.

BUDS—Alternate, covered by 4 yellowish, glandular-dotted scales occurring in valvate pairs. Terminal bud evidently-elongated, flattened, blunt-pointed. Lateral buds usually superposed; the lowest or axillary one usually small and sharp-pointed; the upper one larger, evidently-stalked and angular.

LEAVES—Alternate, compound, with 7-11 leaflets, 6-10 inches long. Leaflets lanceolate to ovate-lanceolate, lateral ones sessile, sharp-pointed at apex, finely toothed on margin, obliquely tapering or heart-shaped at base; when mature dark yellowish-green above, paler below.

LEAF-SCARS—Alternate, large, conspicuous, raised, heart-shaped, triangular to elliptical, lighter than twigs, containing numerous bundle-scars arranged in 3 groups or in a single curved line or occasionally scattered irregularly over whole scar.

FLOWERS—Appear about May when leaves are half-developed. Staminate and pistillate flowers separate. Staminate green and arranged in triple-clustered aments about 3-4 inches long. Pistillate, and small clusters on the new growth about ½ of an inch long, somewhat angled and scurfy-hairy.

FRUIT—Matures about October; spherical to obovate about ¾-1½ inches long. Husk thin, yellowish glandular-dotted, splits open to about the middle into four valves; before splitting appears 4-winged from apex to about the middle. Nut thin-shelled, at least as broad as long, smooth, short-pointed, with reddish-brown and very bitter kernel.

WOOD—Wood of this species resembles the wood of the other Hickories, described on page 106, only it is somewhat lighter, not quite so strong, of somewhat less fuel value, more brittle, less stiff, and yields more ash when burned.

DISTINGUISHING CHARACTERISTICS—The Bitter Nut Hickory, also known as Swamp Hickory and Bitter Hickory, can be distinguished by its lanceolate leaflets which are pubescent beneath, and smaller than those of any other native Hickory. It is the only native species which has yellow buds with 4-6 bud-scales arranged in valvate pairs. Its terminal buds are flattened and elongated while the lateral buds are evidently-stalked and superposed. The nut is globular, short-pointed, thin-walled, containing a bitter kernel, and is covered by a thin husk which in time splits open from the apex to about the middle. The bark is rough, but does not scale off, which characteristic it has in common with the Pignut and the Mocker Nut.

RANGE—Quebec to Minnesota and Nebraska and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Local throughout the southeastern and southern parts. Also reported from the central and northern parts. Nowhere common. Usually solitary and scattered.

HABITAT—Prefers low, wet, and fertile situations such as border of streams and farmers' woodlots located in rich agricultural regions. Often found, however, far up the slopes of mountains. It ascends to the top of the South Mountains in Pennsylvania. Not very tolerant of shade.

IMPORTANCE OF THE SPECIES—This species produces valuable wood but its fruit is not edible. It grows best on rich moist soil such as one usually finds in a farmer's woodlot. It endures transplanting better and grows more rapidly than any other of our Hickories. This valuable wood is becoming rare. A future supply should be insured by developing this tree in mixture with others in the farmer's woodlot and in fertile portions of larger forests. It is not gregarious but prefers to grow as a single specimen in mixture with other species.

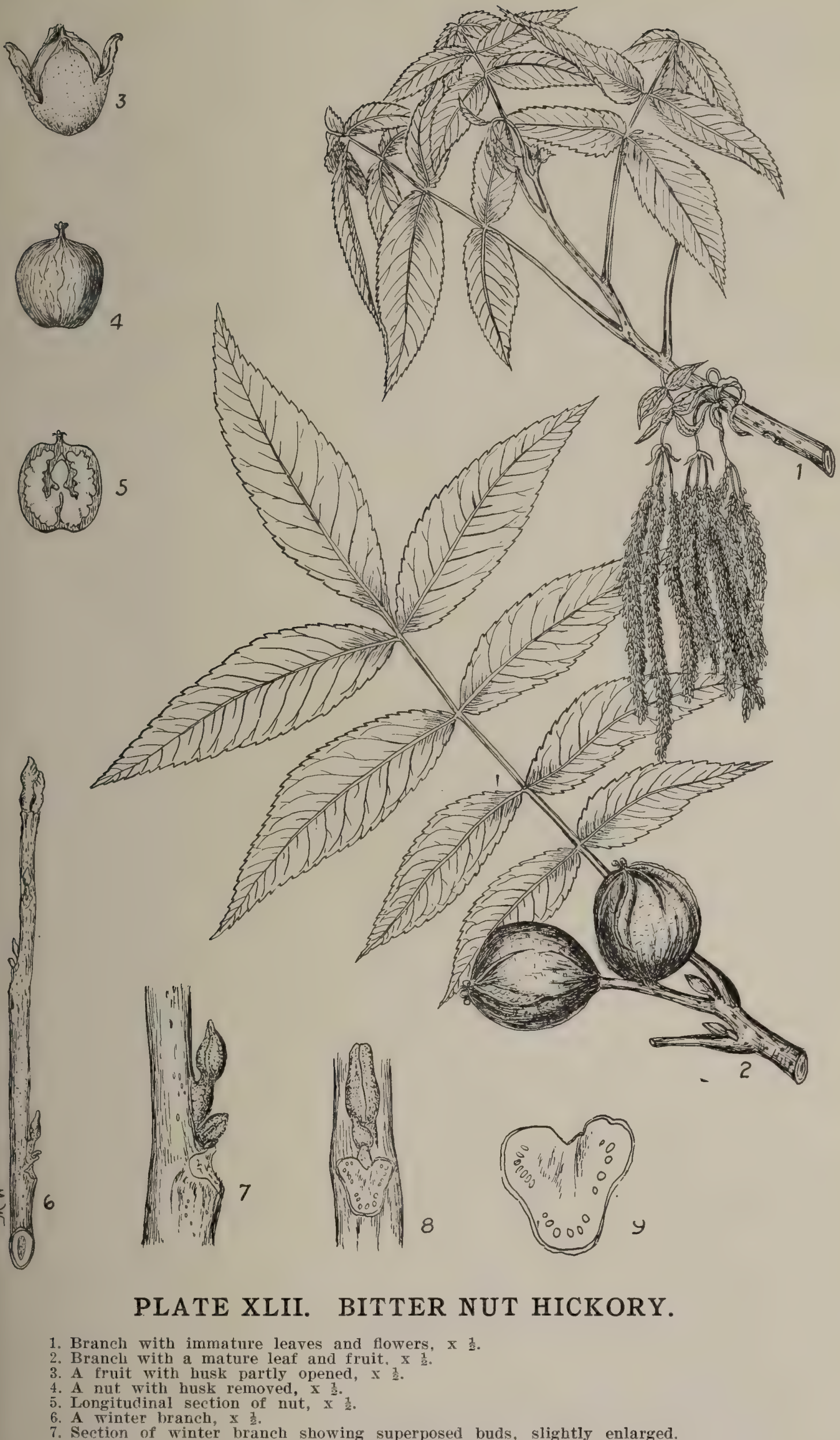

PLATE XLII. BITTER NUT HICKORY.

1. Branch with immature leaves and flowers, x ½.
2. Branch with a mature leaf and fruit, x ½.
3. A fruit with husk partly opened, x ½.
4. A nut with husk removed, x ½.
5. Longitudinal section of nut, x ½.
6. A winter branch, x ½.
7. Section of winter branch showing superposed buds, slightly enlarged.
8. Section of winter branch showing superposed buds and leaf-scar, slightly enlarged.
9. A leaf-scar with bundle-scars, enlarged.

THE BIRCH FAMILY—BETULACEAE.

The Birch family comprises 6 genera with about 75 species of trees and shrubs which are confined to the colder part of the northern hemisphere. Of this number 5 genera with about 30 species are native to North America and 5 genera with 11 species to Pennsylvania.

All the members of this family, even though they may belong to different genera, have many morphological features in common. The leaves are simple, alternate, borne singly or in pairs on the branches but never opposite each other. The staminate and pistillate flowers are separate, but are borne on different parts of the same tree and usually on different parts of the same branch. The staminate flowers are long, usually in drooping aments, or in spike-like or knob-like aments and may be with or without a perianth. The fruits are small, one-celled, usually subtended by a large bract which in the most important genera develops into a cone-like structure called a strobile.

Various products of high commercial importance are produced by this family. The wood of the Birches is used extensively for furniture, flooring, interior finishing and has a very high fuel value. The fruit of the Hazelnuts is prized as food. The wood of some of the Alders is especially adapted to the manufacture of gunpowder and charcoal. The bark of the Black Birch yields a volatile oil of considerable importance. The technical value of the products from the members of this family are becoming more important every year. The wood of some of the species which was despised formerly, is now considered of high value in some particular industries, on account of the new uses to which it is being put. The science of Xylology, which is merely in its formative period, will do much in advancing the position of the wood of species at present despised or at least not fully known. The subjoined key will aid in distinguishing the genera of this family.

KEY TO THE GENERA.

Page.

1. Staminate flowers solitary on each bract; pistillate flowers with a perianth; fruit not a strobile, ...2

1. Staminate flowers 2 to several on each bract; pistillate flowers without a perianth; fruit a strobile, ...4

2. Shrubs: twigs covered with stiff red hairs standing out at right angles; nuts large covered by leaf-like involucre, ...**Corylus** 122

2. Trees: Twigs not covered with stiff red hairs; nuts small and subtended by a large bract, ...3

3. Bark close, smooth and fluted; nut subtended by a flat 3-lobed bract, terminal lobe serrate on one side, ...**Carpinus** 120

3. Bark thin covered by loose ribbon-like narrow brown scales; nut subtended by a closed bract arranged in hop-like clusters, ...**Ostrya** 119

4. Shrub with close, somewhat fluted bark; wood yellowish upon exposure; buds stalked, obtuse at apex, covered with two exposed valvate scales; fruit woody and persistent, ...**Alnus** 121

4. Small to large trees with loose bark usually peeling off into thin film-like layers; buds not stalked, acute at apex, covered with 3 or more overlapping scales; fruit membranous and deciduous, ...**Betula** 112

THE BIRCHES—BETULA, Tournefort (L.)

This genus comprises about 35 known species of which numbe 25 are trees and the others shrubs. Of the known species about 1 are native to North America and 5 to Pennsylvania.

The members of this genus are without exception called Birches In most of them the bark of the trees when young is smooth an peels off into film-like papery layers which vary in color accordin to the species from chalky white to reddish-brown. A few specie have, however, a close and smooth bark which does not peel off int thin film-like papery layers. The wood is dense and hard, does no show the annual rings very clearly, is of high fuel value and usuall reddish-brown in color, sometimes possessing a highly prized curl or wavy figure. The twigs of the season produce only one leaf at point, while the twigs of the previous season produce two leaves fro the lateral buds situate on the short spur-like branches. The leave are simple, always alternate, occur singly or in pairs but never o posite. The flowers appear before or with the developing leaves. Th staminate flowers appear clustered in long tassel-like bodies hangin down from the end of the twigs and are known as aments. The pi tillate flowers appear below the staminate and are nearly erec rather small and slender. The fruit is a cone-like structure know as a strobile consisting of a central axis to which numerous scal are attached. The scales are thin, 3-lobed, and bear the small fl nuts with their wings. The nuts are very light and easily scatter by the wind for considerable distances from the mother or seed tree

The commercial products derived from some of the members of th genus are rather important and valuable. The species found in t eastern part of North America yield products of more value tha those found in the western part. Most of the species found in t western part of North America are too small, or infrequent in t form of stands, to be commercially important for general or ev domestic use. Some of the species found in the eastern part of Nor America are also small shrubs but others reach the size of large ti ber trees which yield not only excellent wood but also valuable oi flavors, and bark.

The subjoined key will aid in distinguishing the species of Bir found in Pennsylvania. Separate summer and winter keys were n developed since the following key is based primarily upon bark cha acteristics which are present at all seasons of the year.

KEY TO THE SPECIES.

		Page.
1.	Bark usually separating into thin film-like papery layers, ...2	
1.	Bark close, not separating into thin film-like papery layers, ...4	
2.	Outer bark white in color, ...**B. alba var. papyrifera**	114
2.	Outer bark not white in color. 3	
3.	Outer bark yellow in color; strobiles usually sessile; leaves usually rounded at base, ...**B. lutea**	115
3.	Outer bark reddish-brown, close, inner bark tinged with red; strobiles slender-stalked; leaves usually wedge-shaped at base, ...**B. nigra**	116
4.	Bark chalky white covered with black triangular spots below insertion of lateral branches; small tree, often in clumps; leaves long-acuminate, ...**B. populifolia**	117
4.	Bark dark reddish-brown; large tree, usually occurs singly; leaves ovate with acute apex; twigs and inner bark with wintergreen-like taste, ...**B. lenta**	118

PAPER BIRCH.

Betula alba var. papyrifera, (Marshall) Spach.

FORM—A large tree usually attaining a height of 50-75 ft. with a diameter of 1-2 ft., but may reach a height of 80 ft. with a diameter of 3 feet. Trunk in open grown trees short and covered nearly to the base with lateral, often ascending branches; in close stands branchless below and bearing a narrow open head.

BARK—On trunk and older branches chalky to creamy white and peeling off in thin film-like layers which are tinged with yellow and covered with horizontally-elongated lenticels. On older trunks rough and often fissured into irregular thick scales.

TWIGS—Rather stout, somewhat viscid, decidedly hairy, at first greenish, later becoming smooth, reddish-brown, and after several years, bright white, like the trunk, covered with pale, horizontally-elongated, orange-colored lenticels.

BUDS—Alternate, ovate, sharp-pointed, divergent, about ¼ of an inch long, dark chestnut-brown in color, covered by a few overlapping bud-scales with downy margins.

LEAVES—Alternate, simple, ovate, 2-3 inches long, 1½-2 inches wide, rather firm in texture; upper surface dark green, under surface light green; narrowed or rounded at the base, sharply toothed on the margin and sharp-pointed at the apex.

LEAF-SCARS—See "Leaf-Scars" under Black Birch, page 118.

FLOWERS—Appear in April or May before the leaves. The staminate are arranged in aments, which occur in groups of 2-3 and are about ¾ to 1½ inches long, becoming 3½-4 inches long in spring. The pistillate have light green lanceolate scales and bright red styles, and are arranged in clusters about 1-1¼ inches long.

FRUIT—A cylindrical, short-stalked strobile about 1½ inches long. Scales long, with thick lateral lobes and a rather long terminal lobe. Seeds small and winged. Wings wider than the nut.

WOOD—Diffuse-porous; rays small and inconspicuous; light, strong, hard, light brown tinged with red, with rather thick, light sapwood. Weighs 37.11 lbs. per cubic foot. Used extensively for spools, shoe lasts, pegs, fuel, and in the manufacture of paper pulp.

DISTINGUISHING CHARACTERISTICS—The Paper Birch, also known as Canoe Birch and White Birch, may readily be distinguished from all the other species of Birch in Pennsylvania except the Gray Birch, by its characteristic white bark, which is never renewed when once removed. The European White Birch, which is introduced extensively for ornamental purposes, also has a white bark. To distinguish it from the Gray Birch see "Distinguishing Characteristics" under Gray Birch.

RANGE—From Newfoundland to Alaska, south to Pennsylvania, Michigan, Colorado, and Washington. This is one of the few transcontinental species.

DISTRIBUTION IN PENNSYLVANIA—Found only in the northern part of the State. Common but scattered in Tioga and adjoining counties.

HABITAT—Usually found on rich wooded slopes and on the borders of lakes, swamps, and streams; also scattered through the forests of other hardwoods and occasionally through coniferous forests.

IMPORTANCE OF THE SPECIES—This species is commercially of little importance in Pennsylvania on account of its limited distribution. It is not of sufficient importance to justify its artificial propagation, but wherever it occurs naturally it should be protected so as to insure an abundant future growth. The wood is sufficiently prized to justify its conservative utilization, and also its protection, where nature produces it gratuitously.

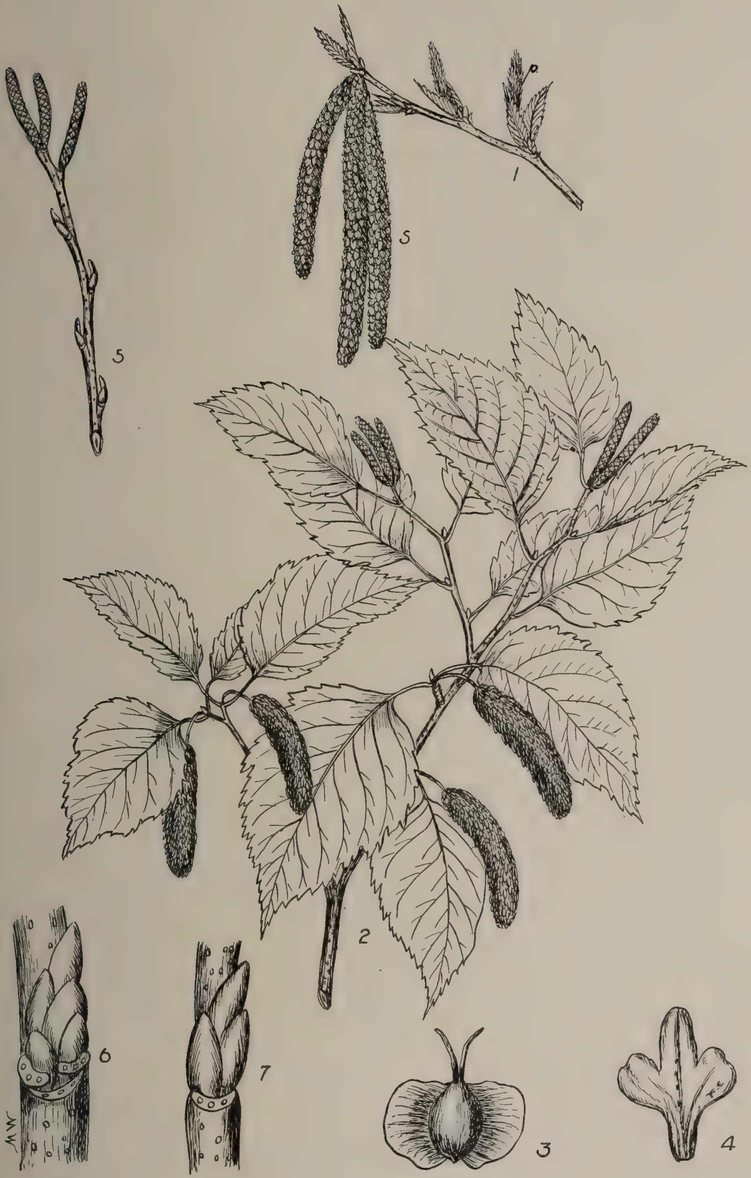

PLATE XLIII. PAPER BIRCH.

. Flowering branch with immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
. Branch with mature leaves, fruiting strobiles, and partly developed staminate aments, x ½.
. A winged seed, enlarged.
. A strobile scale, enlarged.
. A winter branch with 3 partly developed terminal staminate aments, x ½.
. Section of a lateral winter spur-branch, enlarged.
. Section of a terminal winter branch, enlarged.

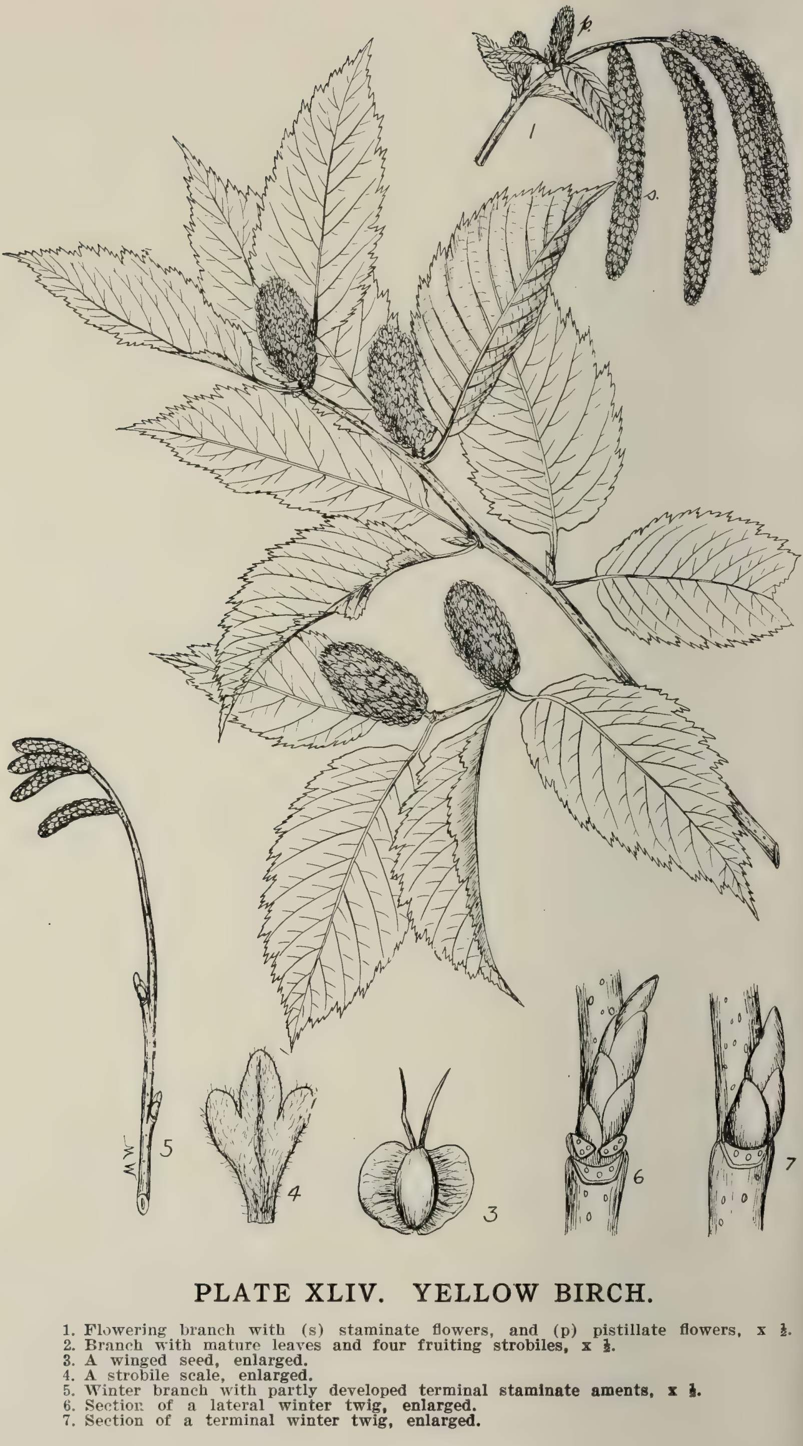

PLATE XLIV. YELLOW BIRCH.

1. Flowering branch with (s) staminate flowers, and (p) pistillate flowers, x ½.
2. Branch with mature leaves and four fruiting strobiles, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. Winter branch with partly developed terminal staminate aments, x ½.
6. Section of a lateral winter twig, enlarged.
7. Section of a terminal winter twig, enlarged.

YELLOW BIRCH.

Betula lutea, Michaux.

FORM—A large tree usually attaining a height of 60-80 ft. with a diameter of 2-3 ft., but may reach a maximum height of 100 ft. with a diameter of 3-4½ feet. Trunk in the open usually short, branching near the base; its long slender branches forming a wide open rather hemispherical crown, in close stands often rather free from lateral branches.

BARK—Close and furrowed or peeling off in thin yellow film-like papery scales. Varies with the age and location of the tree. On young trunks and branches rather close, shining, yellow but soon forming a ragged fringe, later peeling off into thin, yellow, film-like, papery layers. On old trunks it finally becomes reddish-brown and roughened with fissures. The ragged bark is often pulled off and used by campers to start fires in wet weather. See Fig. 68.

TWIGS—At first green and hairy, later brown and smooth, finally dull silvery-gray. Terminal twigs long and slender; lateral short and stout; usually covered with elongated horizontal lenticels which in time unite to form a long horizontal line.

BUDS—Similar to those of the Black Birch, but sometimes slightly more downy. See page 118.

LEAVES—Alternate, simple, occur singly or in pairs but never opposite, 3-4 inches long, ovate, wedge-shaped or heart-shaped at base, doubly serrate on margin, acute at apex, dull green above, yellowish-green below.

LEAF-SCARS—Similar to those of the Black Birch in particular, and all of the other Birches in general.

FLOWERS—Appear about April before the leaves. Staminate and pistillate separate, but usually on the same branch. Staminate are formed in the fall, remaining over winter as aments about ¾ of an inch long which elongate to about 3 inches in spring. Pistillate about ⅝ of an inch long. with acute scales which are light red and hairy above, and green below.

FRUIT—An erect, usually very short-stalked strobile, about 1-1½ inches long, ovate in outline, consisting of numerous 3-lobed scales fastened to a central axis and bearing small winged nuts with rather narrow wings.

WOOD—Diffuse-porous; rays indistinct; heavy, hard, strong, compact, not durable when in contact with the soil. Heart-wood light brown, tinged with red; sap-wood pale in color. Weighs 40.84 pounds per cubic foot. Used for furniture, flooring, interior finish, boxes, certain veneers and fuel.

DISTINGUISHING CHARACTERISTICS—The Yellow Birch, also known as Silver and Gray Birch, can readily be distinguished from the other Birches of Pennsylvania by its yellow bark which peels off into thin, film-like, papery scales. Its method of peeling the bark resembles that of the Paper Birch and the Red Birch, but it does not have the white color of the former nor the reddish to greenish-brown color of the latter. The loose, film-like, papery scales of the Red Birch are smaller than those of the Yellow Birch and the strobiles of the former are slender-stalked while those of the latter are usually sessile or very short-stalked.

RANGE—Newfoundland, south to Pennsylvania, and along the mountains to North Carolina and Tennessee, west to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State but most common in the Alleghenies.

HABITAT—Common on moist rich uplands, borders of streams, and in swamps.

IMPORTANCE OF THE SPECIES—The Yellow Birch is one of the largest deciduous trees of northeastern America. Until recently the value of its wood was not fully appreciated, but today it holds a fair position on the lumber market and in the future it will no doubt attain a still better position. It has been classed as one of the most artistic, reliable, and versatile of the hardwoods of this country. With all its good qualities, it has superior associates and consequently cannot be recommended for forestry purposes except on the farmer's woodlot where fuel is especially desired and in such other places where it comes up naturally and other more desired species will not grow to advantage.

RED BIRCH.

Betula nigra, Linnaeus.

FORM—A medium-sized tree usually attaining a height of 30-50 ft. with a diameter of 1-2 ft., but may reach a height of 100 ft. with a diameter of 5 feet. Trunk usually short and divided near the base into a few slightly diverging limbs. Crown rather narrow, oblong, and irregular.

BARK—Varies with the age of the tree and its location on the trunk. On lower part of old trunks dark reddish-brown and roughened by fissures which separate irregular scales. On younger trunks and upper portion of older ones peels off into thin, film-like, papery scales which are reddish-brown to greenish-brown in color and persist for a few years during which time they form a ragged fringe and expose the light red and close bark underneath. See Fig. 65.

TWIGS—Slender, at first hairy and greenish, later smooth, reddish-brown, covered by pale horizontally-elongated lenticels.

BUDS—Alternate, ovate, sharp-pointed, shining, smooth or slightly hairy, covered with usually 3-7 chestnut-brown overlapping scales.

LEAVES—Alternate, simple, broadly ovate, 1½-3 inches long, wedge-shaped at base, acute at apex, doubly-serrate on margin, deep green above, pale yellowish-green below.

LEAF-SCARS—Similar to those of the Black Birch. See page 118.

FLOWERS—Appear about April before the leaves. Staminate and pistillate separate, but usually on the same branch. Staminate formed in the fall, remaining over winter as aments about ¾ of an inch long, usually in clusters of three, which elongate to about 2-3 inches the following spring. Pistillate about ⅓ of an inch long, developing in spring from buds situate below the staminate flowers.

FRUIT—An erect, slender-stalked, pubescent, cylindrical strobile, 1-1½ inches long, consisting of numerous 3-lobed pubescent scales fastened to central axis and bearing small, hairy, winged nuts. Terminal lobe of the scales is larger than the laterals.

WOOD—Diffuse-porous; rays indistinct; light, soft, strong, with light-brown heartwood and pale thin sapwood. Weighs 35.91 pounds per cubic foot. Used in the manufacture of furniture, slack-cooperage, fruit and vegetable baskets, wooden ware, and turnery.

DISTINGUISHING CHARACTERISTICS—The Red Birch, also known as the River Birch, can be recognized by its reddish-brown to cinnamon-red bark which peels off into film-like papery scales. The layers are smaller and less ragged than those of the Yellow Birch which has a decidedly yellow or silvery-yellow colored bark. The Black Birch has a closer bark which does not peel off and the other species of Pennsylvania have a white bark. The River Birch is usually found along streams or in other wet locations which may also aid in distinguishing it.

RANGE—Massachusetts south to Florida, west to Minnesota, Kansas and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State along the banks of the principal rivers and their chief tributaries.

HABITAT—Prefers the banks of streams, lakes, pools, and swamps. Occasionally found upon drier locations. It is called River Birch because it is usually found along the banks of rivers or other locations having similar moisture conditions.

IMPORTANCE OF THE SPECIES—The Red Birch is of little commercial importance in Pennsylvania as a lumber species on account of the relatively small size which it attains, the softness of its wood, and the absence of figure and attractive color in the wood as well as its limited distribution. It is essentially a southern species reaching its optimum development in North Carolina and adjoining states. While it is of little commercial importance it may be of economic importance in such situations where moisture-loving trees are required to bind soil, as along streams, or where it is desirable to establish stands in extremely swampy locations. It is attractive as an ornamental tree.

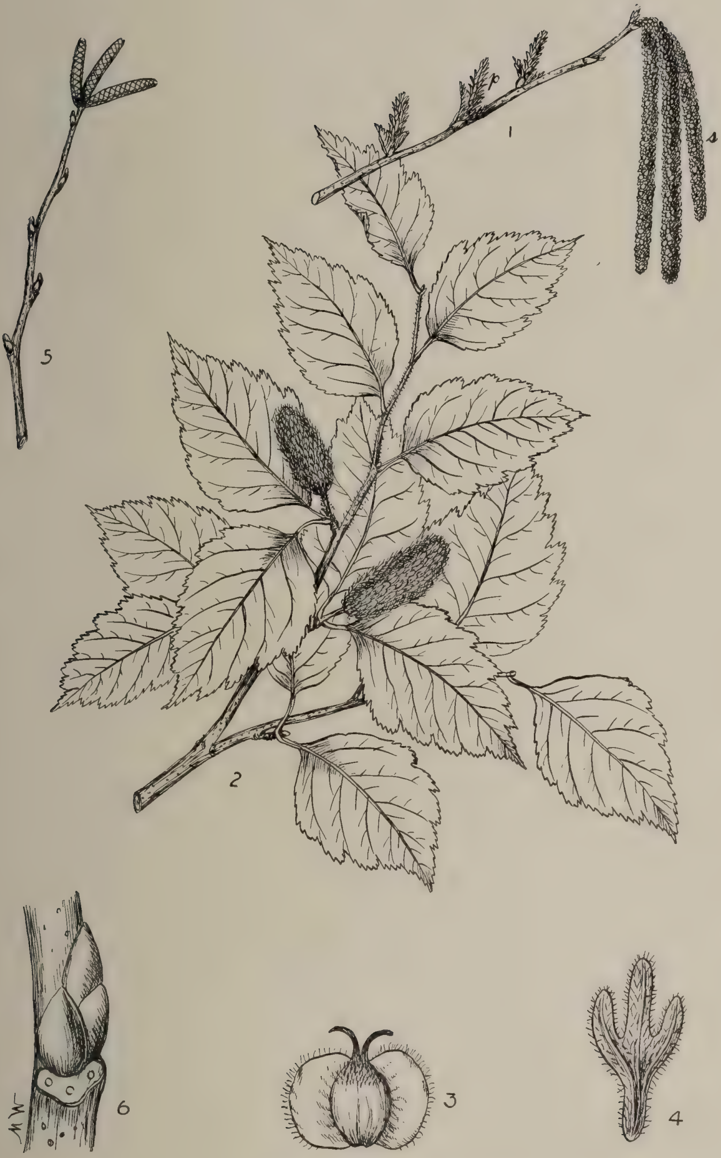

PLATE XLV. RED BIRCH.

1. Flowering branch with (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves and two fruiting strobiles, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. A winter branch with three partly developed terminal staminate aments, x ½.
6. Section of a winter branch, enlarged.

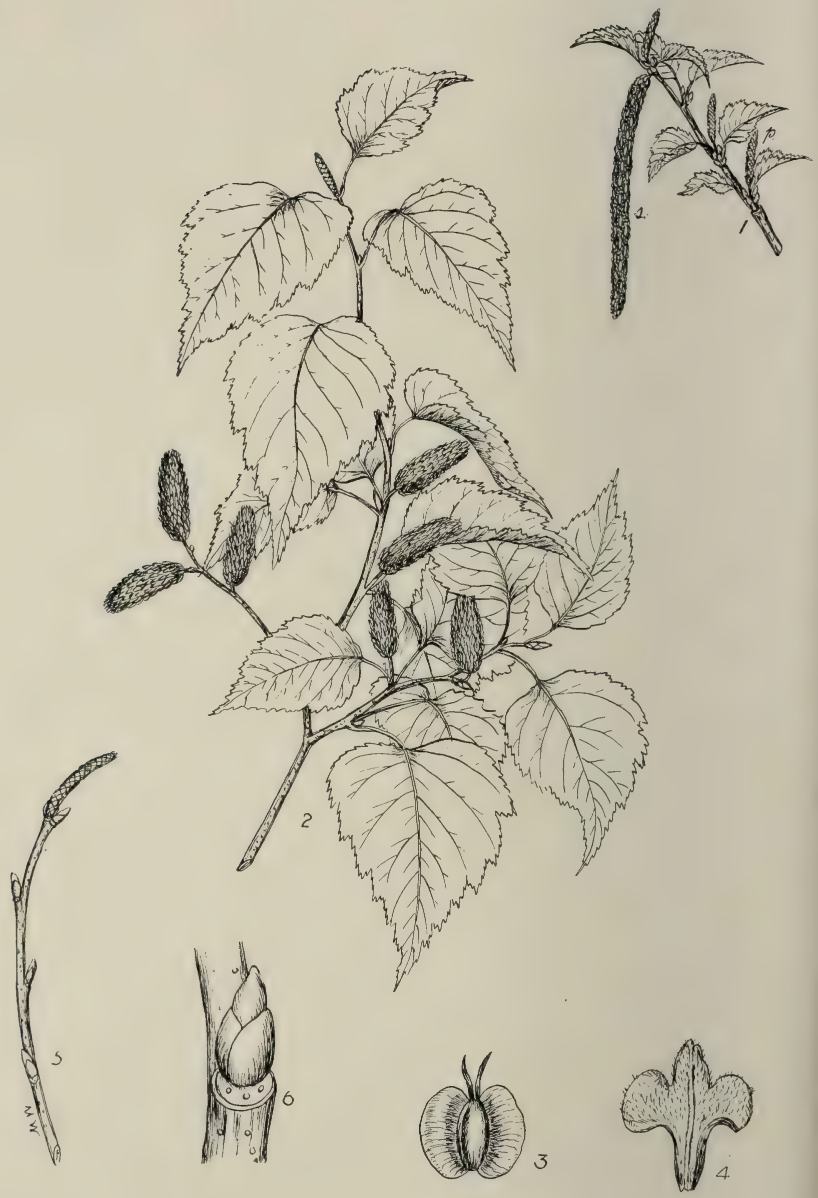

PLATE XLVI. GRAY BIRCH.

1. Flowering branch with immature leaves (s) staminate flowers, (p) pistillate flowers, x
2. Branch with mature leaves and fruiting strobiles, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. A winter branch with a partly developed terminal staminate ament, x ½.
6. Section of a winter twig, enlarged.

GRAY BIRCH.

Betula populifolia, Marshall.

FORM—A small tree usually occurring in clumps and attaining a height of 20-30 ft. with a diameter of 9 inches, but may reach a height of 45 ft. and a diameter of 18 inches. Trunk slender, often inclined, continuous, and covered with ascending lateral branches with drooping ends which form a narrow pyramidal, rather open, and pointed crown.

BARK—Dull white, close, smooth, not peeling off into thin film-like layers but covered with triangular black spots below the insertion of the lateral branches. On old trunks black and roughened with fissures. Inner bark orange-yellow. See Figs. 64 and 69.

TWIGS—Slender, greenish to brown, roughened by warty exudations and by raised, pale, and horizontally-elongated lenticels; later smooth and dull white.

BUDS—Alternate, 2-ranked, ovate, 1/5 of an inch long, sharp-pointed, divergent, covered with 3-4 visible smooth, slightly resinous, brown bud-scales with downy margins.

LEAVES—Alternate, simple, triangular, ovate, 2½-3 inches long, 1½-2 inches wide, wedge-shaped at base, decidedly serrate on margin, with long-toothed apex and long, slender petioles which cause the leaves to quiver when stimulated by a slight breeze only.

LEAF-SCARS—See "Leaf-Scars" under Black Birch, page 118.

FLOWERS—Appear about April before the leaves. Staminate in solitary or occasionally paired aments which are about 1¼-1½ inches long and ⅛ of an inch wide during the winter, but develop in spring to a length of 2-4 inches. Pistillate cylindrical, slender, about ½ of an inch long and stalked.

FRUIT—A slender, cylindrical, stalked strobile about ¾ of an inch long and obtuse at the apex. Scales small and downy; their lateral lobes broad and recurving, while the terminal one is rather straight and narrow. Seeds small, oval, and winged. Wings broader than the seed.

WOOD—Diffuse-porous; rays inconspicuous; light, soft, not strong, not durable; heartwood light brown; sapwood light. Weighs 35.90 pounds per cubic foot. Used for fuel, and in the manufacture of paper pulp, spools, shoe pegs, and hoops for barrels.

DISTINGUISHING CHARACTERISTICS—The Gray Birch, also known as Oldfield, White, Poverty, or Poplar Birch, can be distinguished from all the other Birches of Pennsylvania, except the native Paper Birch, and the commonly introduced European White Birch, by its white bark which is never renewed when once removed. The bark is close, dull white, and marked with black triangular blotches just below the insertion of the lateral branches, and does not peel off in thin paper-like layers like that of the Birch. The Gray Birch is usually a small tree with a rather continuous trunk and frequently occurs in clumps. The twigs of the Gray Birch are also rougher than the Paper Birch and its leaves are long-acuminate, while those of the Paper Birch are ovate.

RANGE—Nova Scotia south to Delaware and southern Pennsylvania, west to the southern shores of Lake Ontario.

DISTRIBUTION IN PENNSYLVANIA—Locally in the mountainous portion. Common in Monroe, Schuylkill and Pike counties. Abundant along streams in northern part of the State. A few specimens found on top of South Mountains in Franklin county near Mason and Dixon line.

HABITAT—Usually occurs on moist soil along streams, ponds, and lakes; also grows on hillsides and occasionally on rocky mountain tops.

IMPORTANCE OF THE SPECIES—This species is of little commercial value on account of the small size which it attains due to its short life. The existing stands should, however, be conservatively utilized. It cannot be recommended for forest planting, but is an extremely attractive tree for ornamental purposes.

BLACK BIRCH.

Betula lenta, Linnaeus.

FORM—This tree usually attains a height of 50-60 ft. with a diameter of 1-3 ft., but may reach a height of 80 ft. with a diameter of 5 feet. Trunk rather continuous, sometimes subdivided, bearing long, slender, lateral branches which are ascending on young trees forming a narrow conical crown, or often pendulous on old specimens forming a wide spreading crown.

BARK—On old trunks (Fig. 71) distinctly black, broken into large, thick, irregular plates which are smooth on the surface; on younger parts of the trees (Fig. 70) smooth, shining, very close fitting, reddish-brown, with sweet wintergreen taste and covered with horizontally-elongated lenticels.

TWIGS—During the first summer light green and hairy, later becoming reddish-brown, smooth, shining, with pronounced wintergreen-like flavor. Terminal twigs slender and elongated, while lateral spurs are numerous, stout, and short.

BUDS—Alternate, about ¼ of an inch long, conical, sharp-pointed, shining, covered with reddish-brown overlapping scales with downy margins. Three bud-scales usually visible on buds of terminal shoot and from 5-8 on lateral spur shoots.

LEAVES—Alternate, simple, ovate, usually heart-shaped at base, serrate on magrin, long-pointed at apex, dark green above, pale green below, 2½-5 inches long, 1½-3 inches wide.

LEAF-SCARS—Alternate, small, semi-oval in outline, containing 3 rather small, equidistant bundle-scars.

FLOWERS—Appear about April before the leaves. Staminate formed in fall, remaining over winter as aments about ¾ of an inch long, in clusters of usually three, which elongate to about 3 or 4 inches the following spring. Pistillate about ½-¾ of an inch long, slender, and pale green.

FRUIT—A strobile about 1½-2 inches long, sessile, smooth, erect, with smooth 3-lobed scales and small winged nutlets. Lobes of the scales are about equal in length but the terminal is narrower and sharper-pointed.

WOOD—Diffuse-porous; rays indistinct; heavy, strong, hard, dark brown, with thin yellowish sapwood. Weighs 47.47 lbs. per cubic foot. Used for furniture, often in imitation of Mahogany, and for interior finish; also substituted for Cherry and occasionally for Hickory. Trees cut in spring at about the time the buds open, bleed more than any other species, but the sap contains less saccharine material than that of the Maples.

DISTINGUISHING CHARACTERISTICS—The Black Birch, also known as Sweet Birch, and Cherry Birch, can be distinguished from all the other species of Birch in Pennsylvania by its close, blackish, cherry-like bark which does not peel off into film-like layers. It closely resembles the Yellow Birch but the latter has yellow bark which peels off into thin film-like layers. The twigs have a distinctly wintergreen-like flavor which is absent in the other species. The scales of the fruit of the Black Birch are smooth about equally lobed while those of the Yellow Birch are hairy and irregularly lobed.

RANGE—Newfoundland to Florida, west to Ontario, Illinois and Tennessee.

DISTRIBUTION IN PENNSYLVANIA—Common throughout the State, and locally frequent.

HABITAT—Usually found in rich soil and on dry slopes but also common on rocky mountain slopes and tops. Common on the rocky ridges of the South Mountains in Pennsylvania.

IMPORTANCE OF THE SPECIES—The Birches, next to the Hickories, furnish the best fuel wood of all the native species of Pennsylvania. The wood of Black Birch ranks high as a fuel wood and is becoming more important in the manufacture of furniture, especially as a substitute for Mahogany and Cherry. This tree also yields an oil sold as a substitute for wintergreen. While this species has many good qualities still it is a slow grower and when quite young is subject to the attack of fungi, which materially decrease the technical value of the wood. It is not of sufficient importance to be regenerated artificially but should be developed where it appears naturally. This species occurs naturally upon extremely rocky ridges and may be a very desirable species in establishing protection forests upon steep mountain slopes and rocky mountain tops.

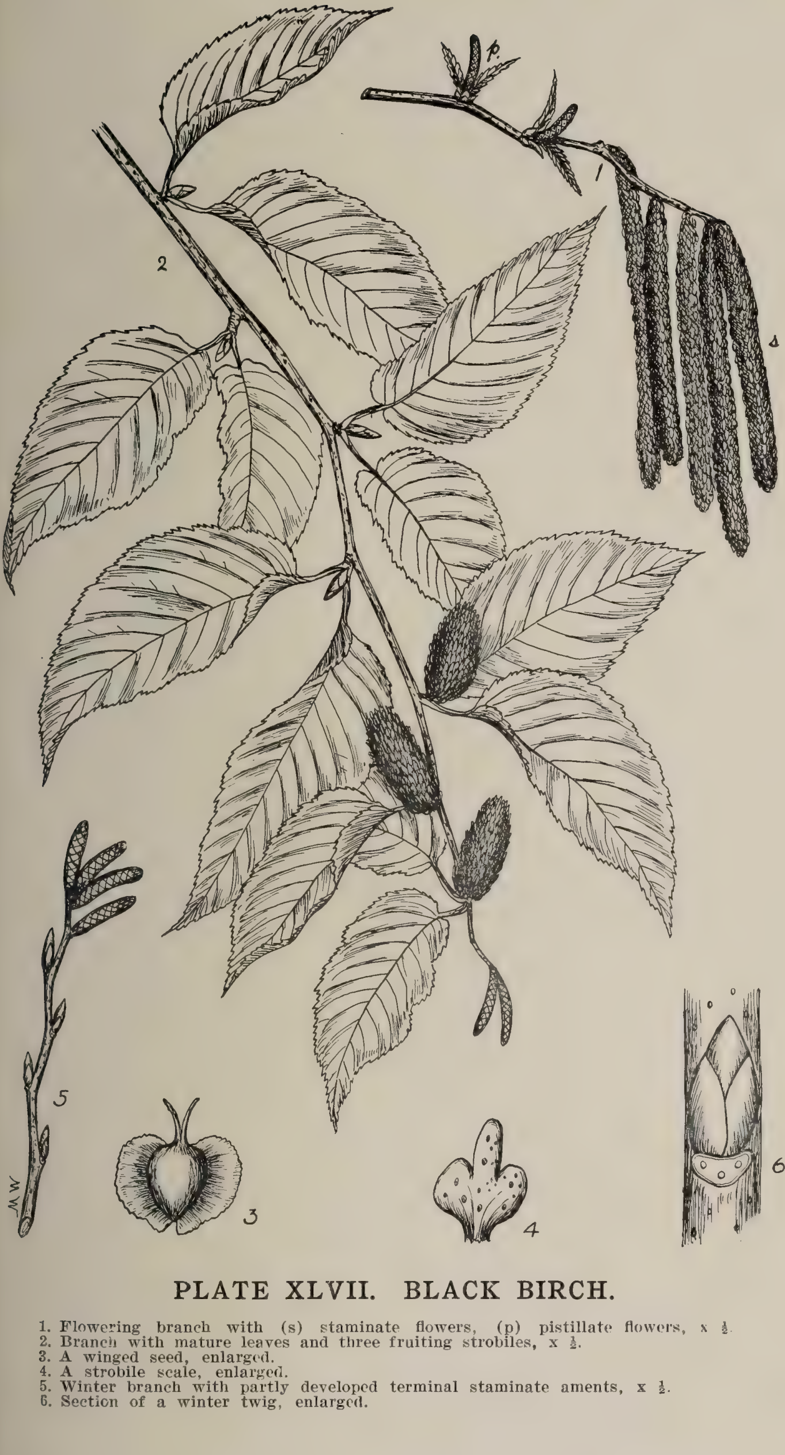

PLATE XLVII. BLACK BIRCH.

1. Flowering branch with (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves and three fruiting strobiles, x ½.
3. A winged seed, enlarged.
4. A strobile scale, enlarged.
5. Winter branch with partly developed terminal staminate aments, x ½.
6. Section of a winter twig, enlarged.

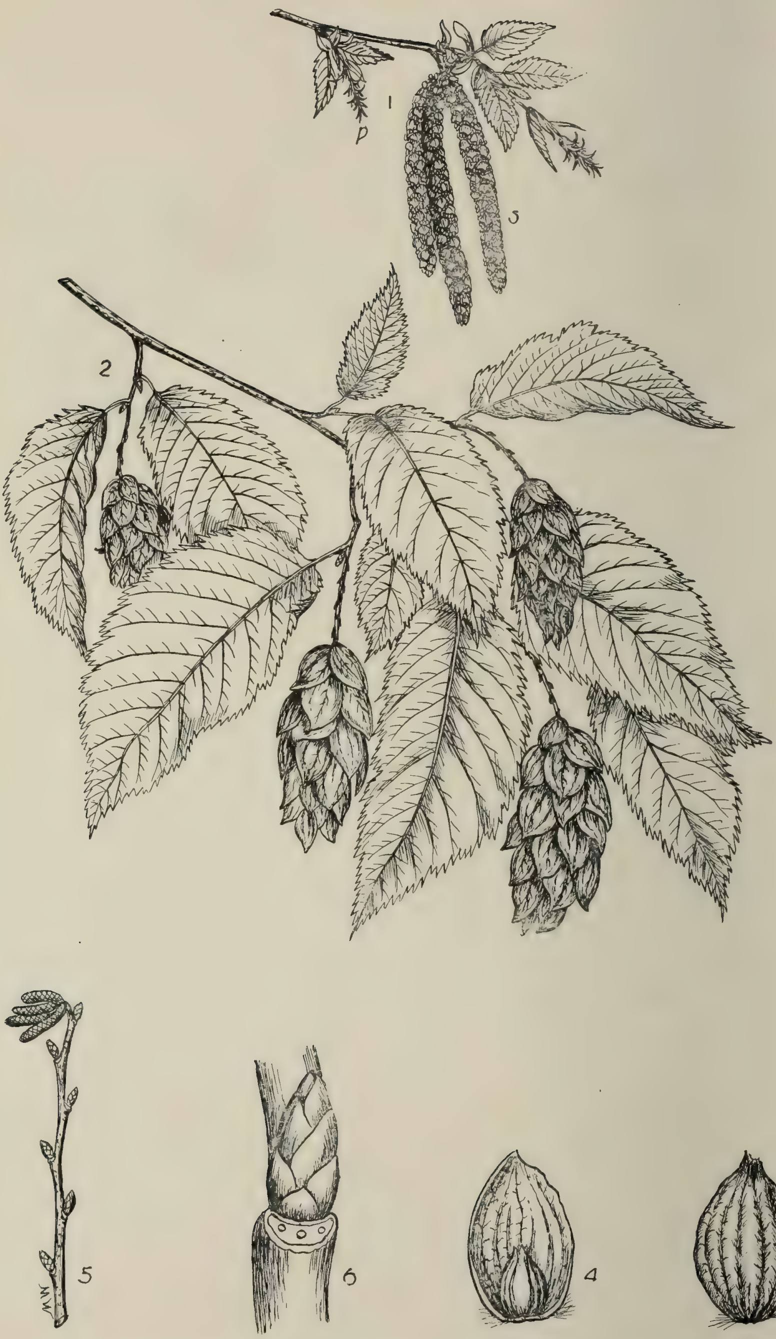

PLATE XLVIII. AMERICAN HOP HORNBEAM.

1. Flowering branch with immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves and hop-like fruit clusters, x ½.
3. A seed with inclosing membrane, slightly enlarged.
4. A seed with part of inclosing membrane removed, slightly enlarged.
5. A winter branch with partly developed terminal staminate aments, x ½.
6. Section of winter twig, enlarged.

AMERICAN HOP HORNBEAM.

Ostrya virginiana, (Miller) K. Koch.

GENUS DESCRIPTION—This genus comprises about 4 species which are widely distributed in the northern hemisphere. Two species are native to America and 2 to the eastern hemisphere. One of the American species is more limited in its distribution than any other known tree, being found only in the Grand Canon of the Colorado River in Arizona while the other American species is rather widely distributed over the eastern part of the country.,

FORM—Usually attains a height of 20-30 ft. with a diameter of 1½ ft., but may reach a height of 60 ft. with a diameter of 2 feet. Crown high, open, and very broad, formed by widely spreading often drooping branches with ascending branchlets.

BARK—Grayish-brown, thin, roughened by loose flattish scales which are loose at the ends. See Fig. 54.

TWIGS—Slender, tough, dark reddish-brown, zigzag, at first hairy and green, later smooth, lustrous, dark brown.

BUDS—Alternate, axillary; terminal bud absent; ovate, ¼ of an inch long, sharp-pointed, distinctly divergent, slightly pubescent, smooth, gummy, covered by about 8 visible, longitudinally-striated, 4-ranked scales which increase in size from the base towards the apex.

LEAVES—Alternate, simple, ovate-oblong, acute at apex, doubly-serrate on margin, rounded or heart-shaped or wedge-shaped at base, 3-5 inches long; dull yellowish-green above, paler green below.

LEAF-SCARS—Alternate, small, flattened, 2-ranked, with usually 3 small bundle-scars.

FLOWERS—Appear about April with the leaves. Staminate aments appear about midsummer usually in about 3s at the end of the twigs and persist during the winter; they are stiff, hairy, about ½ of an inch long, becoming about 2 inches long in spring and covered with reddish-brown scales. Pistillate flowers appear in erect aments, each one inclosed in a hairy bladder-like bract.

FRUIT—A small flat nutlet, inclosed in an inflated bladder-like bract which is covered at the base with long hairs irritating to the skin. Bracts arranged in hop-like, pendant clusters which fall during winter and leave the persisting naked stalk.

WOOD—Diffuse-porous; rays indistinct; strong, hard, durable, light brown to white. Weighs about 51 lbs. per cubic foot. Used for fence posts, tool handles, and mallets.

DISTINGUISHING CHARACTERISTICS—The American Hop Hornbeam, also known as Ironwood, Leverwood, and Deerwood, can readily be recognized by its thin grayish-brown bark which peels off into narrow flat scales often loose at both ends and only attached in the middle. The hop-like clusters of sac-like fruit are also peculiar, which usually fall before winter but the stalks to which they are attached often persist. In winter the very slender interlacing branches, the staminate catkins usually occurring in 3s at the end of the twigs, the small 2-ranked leaf-scars with 3 bundle-scars, and the small reddish-brown buds with 4-ranked scales are characteristic. The autumnal color of the leaves is yellow while that of the closely related American Hornbeam is brilliant orange to deep scarlet. The hardness of the wood is also distinctive. The wood is about 30 per cent. stronger than White Oak.

RANGE—Cape Breton Islands to Florida, west to Minnesota and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State but nowhere abundant. Usually mixed with other species. Rarely conspicuous in the composition of the forest.

HABITAT—Prefers dry gravelly slopes and ridges, occasionally moist situations. Usually seeks cool and shaded situations, and is never found in pure stands or groups, but occurs singly in mixture, often as an undergrowth of Oak, Maple, Chestnut, and other forest species common to its range.

IMPORTANCE OF THE SPECIES—The American Hop Hornbeam produces a valuable wood and grows rapidly, but its solitary habits as well as its silvicultural characteristics and the relatively small size which it attains, do not recommend it for forestry purposes. It is well adapted for planting in lawns and parks.

AMERICAN HORNBEAM.

Carpinus caroliniana, Walter.

GENUS DESCRIPTION—This genus comprises about 12 species which are confined to the northern hemisphere. Only 1 species is found in America. A few of the other species are native to Europe, while most are found in northern and central Asia.

FORM—A small tree or shrub usually attaining a height of 10-30 ft, with a diameter of 8-12 inches, but may reach a height of 40 ft. with a diameter of 2 feet. Trunk usually short, fluted, and bearing a wide-spreading usually round-topped crown with tough ascending branches often pendulous towards the end.

BARK—Vertically corrugated, smooth, thin, close-fitting, bluish-gray tinged with brown. See Fig. 93.

TWIGS—Slender, at first silky, hairy, and green, later smooth, shining, reddish to orange; covered with scattered pale lenticels.

BUDS—Alternate, axiliary; terminal bud absent; ovate, pointed, ⅛ of an inch long, reddish-brown, covered with 8-12 visible 4-ranked bud-scales. Bud-scales increase in size from the base towards the apex, are longitudinally-striate and often ciliate on margins.

LEAVES—Alternate, simple, ovate-oblong, acute at apex, doubly-serrate on margin, rounded or wedge-shaped at base, 2-4 inches long, deep green above, paler below.

LEAF-SCARS—Alternate, small, elevated, elliptical, with generally 3 inconspicuous bundle-scars.

FLOWERS—Appear about April with the leaves. Staminate start to develop in fall and remain over winter in the form of buds which resemble the leaf-buds, only are larger. When fully developed they are drooping aments about 1½ inches long. Pistillate appear as aments, about ⅔ of an inch long, with bright scarlet styles.

FRUIT—A small corrugated nut about ⅓ of an inch long inclosed by a leaf-like, 3-lobed bract which is usually serrate only on one margin of middle lobe.

WOOD—Diffuse-porous; rays conspicuous and broad along short radii; heavy, hard, strong, light brown with broad sapwood. Weighs about 45 lbs. per cubic foot. Used for fuel, tool handles, and levers.

DISTINGUISHING CHARACTERISTICS—The American Hornbeam, also known as the Blue Beech, Ironwood, and Water Beech, may be distinguished by its vertical, corrugated, bluish-gray, smooth bark. The leaf-like 3-lobed bract with its corrugated nut is also characteristic. The staminate catkins remain in the bud during the winter, while those of the American Hop Hornbeam are developed in autumn. It resembles the American Beech, but can readily be distinguished from it by its corrugated bark and the absence of the long, slender, conical, and sharp-pointed buds so characteristic of the Beech. The buds are usually downy at the apex while those of the American Hop Hornbeam are smooth and slightly gummy within. The autumnal color of the leaves is brilliant orange to deep scarlet.

RANGE—Nova Scotia to Florida, west to Minnesota and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State. Sometimes rather abundant and conspicuous in wet habitats. Common in Franklin, Adams, Northampton, Fulton, Centre, Huntingdon, Tioga, and Union counties.

HABITAT—Usually found in swamps and on the border of streams, whence its name Water Beech. In Pennsylvania it is found in the valleys, along streams, in swamps, and in similar habitats on the mountain flats and on moist fertile mountain slopes.

IMPORTANCE OF THE SPECIES—This species on account of its small size, slow growth, and preference for wet locations is of little commercial importance. It cannot be recommended for forestry purposes but is attractive as an ornamental tree on account of its fluted bark, peculiar branching, and the beautiful orange and scarlet autumnal coloration of its foliage.

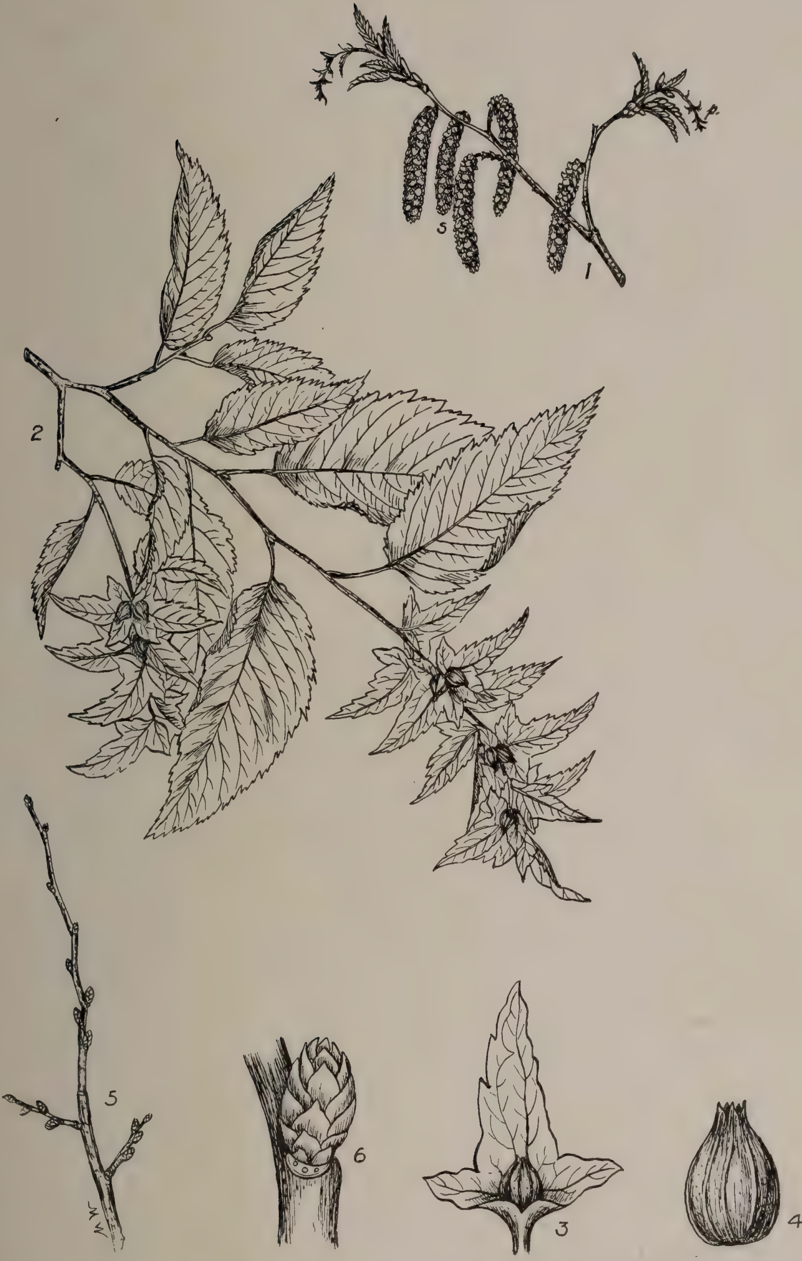

PLATE XLIX. AMERICAN HORNBEAM.

1. Flowering branch with immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
2. Branch with mature leaves and fruit, x ½.
3. A nut with subtending bract, slightly enlarged.
4. Nut with bract removed, enlarged.
5. A winter branchlet, x ½.
6. Section of winter twig, enlarged.

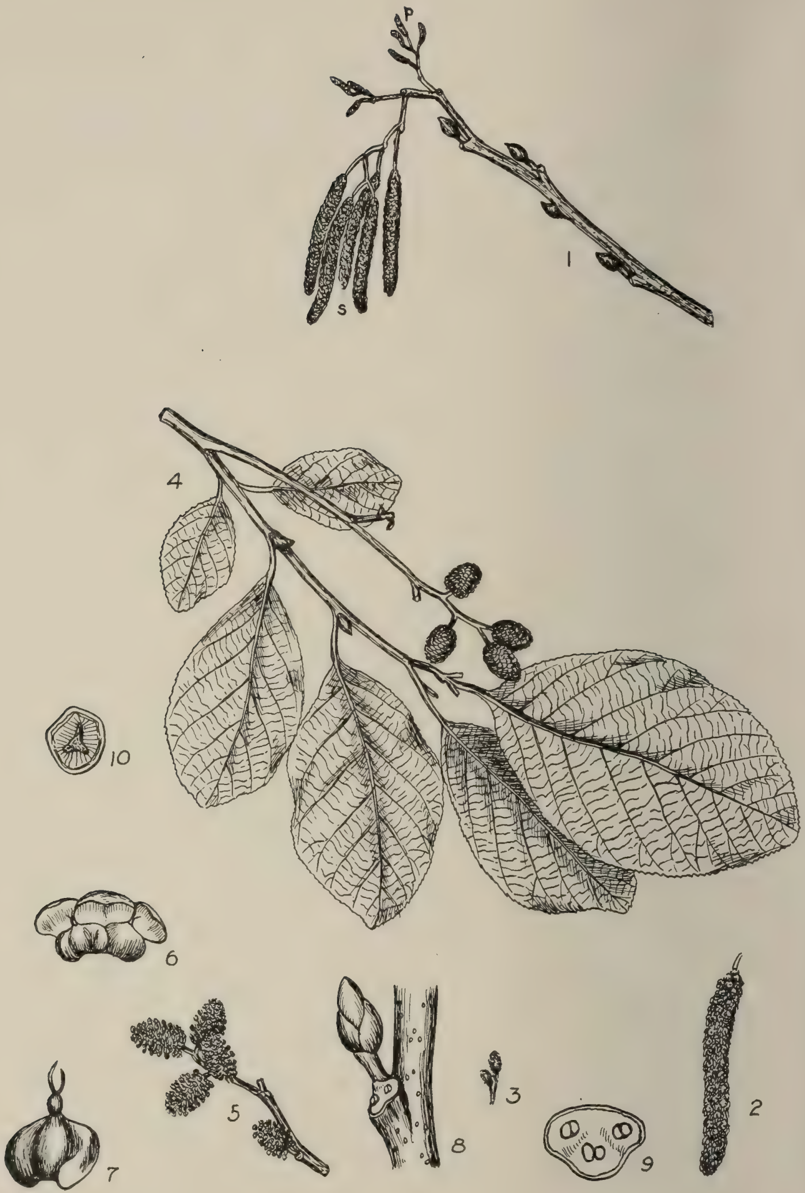

PLATE L. SMOOTH ALDER.

1. Winter branch showing buds, (s) staminate catkins, (p) pistillate catkins, x ⅓.
2. A mature staminate catkin, x ½.
3. Mature pistillate catkins, x ⅓.
4. Branch with leaves and fruit, x ½.
5. Branch with mature fruit strobiles, x ⅓.
6. A strobile scale with seeds, slightly enlarged.
7. A winged seed, enlarged.
8. Section of winter branch showing stalked bud, lenticels, leaf-scar with bundle-scars, slightly enlarged.
9. A leaf-scar, enlarged.
10. Cross section of branch showing triangular pith, enlarged.

SMOOTH ALDER.

Alnus rugosa, (Du Roi) Sprengel.

ENUS DESCRIPTION—The Alders comprise about 25 known species, of which number out 10 species are native to North America and 2 species to Pennsylvania. The members this genus are distributed widely in the northern hemisphere and extend south through ntral America and along the Andes mountains to Bolivia. Most of them are shrubs or small es, while a few attain a fair tree-size.

ORM—A small shrub usually from 4-10 ft. in height. Sometimes solitary, usually in clumps, en forming thickets which are almost impenetrable, especially in wet locations.

ARK—Thin, smooth, fluted, astringent, at first brownish-green, later grayish-green, and en covered with white blotches.

WIGS—Rather slender, at first greenish, later greenish-brown and finally grayish-brown. ten grayish-white towards end of fruiting twigs. Lenticels numerous, scattered, brownish, ndish or longitudinally-elongated. Pith greenish and irregular or triangular.

UDS—Alternate, evidently-stalked, about ½ of an inch long; greenish-red, laterally com- essed, blunt-pointed, apparently covered with two valvate scales which in reality are pules. Stipular bud-scales are often whitish towards apex and usually slightly sticky.

EAVES—Alternate, simple, obovate, blunt-pointed or rounded at apex, usually wedge- aped at base, almost regularly serrate on margin at first slightly gummy, later smooth, ther thick, 2½-4¼ inches long; green on both surfaces, but darker on upper surface, brownish bescent below especially in the axils of the veins. Veins depressed above and ridged low.

EAF-SCARS—Alternate, raised, usually 2 or 3-ranked, somewhat triangular, containing out 3 bundle-scars which are often compounded. Stipule scars narrow, triangular, brownish d very close to leaf-scars.

FLOWERS—Appear in March or April before the leaves. Staminate and pistillate occur parately but on same twig. Staminate in aments which develop partly in previous autumn d remain dormant over winter. In winter they are stiff, pendant, greenish, and about e inch long; in clusters of 2-5 at the end of bare stalks. Pistillate also develop in the evious autumn and remain dormant over winter, are about ¼-½ of an inch long, usually clustered 2s or 3s and greenish to purplish in color. The first warm days of spring bring forth e scarlet styles of the pistillate flowers.

RUIT—A cone-like woody structure, about ½-¾ of an inch long, orbicular, persistent, mposed of thick and woody scales on which the little, practically wingless, round and ttened nutlets are produced.

WOOD—Diffuse-porous; growth rings distinct; rays variable in width. Sapwood turns llowish-brown upon exposure.

DISTINGUISHING CHARACTERISTICS—The Smooth Alder, also known as Black Alder, n be distinguished by the woody cone-like fruit which is usually present at all seasons of e year. The wet habitats which it frequents may also aid in recognizing it. In spring it is e of the first of our small trees to blossom. In summer the stiff leaves with their rounded exes are also characteristic. In winter the mature fruit, developing staminate and pistillate wers, stalked buds, and triangular green pith, are distinctive. The only other Alder tive to Pennsylvania is the Speckled or Hoary Alder (Alnus incana (L.) Moench.) This ecies can be distinguished from the Smooth Alder by its leaf-blades which are usually aucous or finely pubescent and rounded at the base.

RANGE—Essentially a southern species, extending from Maine to Florida and Texas and estward to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Very common in the eastern and southern parts the State. Sparse and locally abundant in northern and western parts.

HABITAT—Common along streams and in swamps. Rarely ascends the hillsides. In wet tuations it often forms dense thickets.

IMPORTANCE OF THE SPECIES—The two species of Alder native to Pennsylvania do not tain a size which would make them important commercially. They may be of value as il-binders and soil-conservers along the banks of streams or in very wet situations since ey develop large and strong roots which throw off many suckers.

HAZELNUT.

Corylus americana, Walter.

GENUS DESCRIPTION—The Hazlenuts comprise about 7 known species, of which numbe about 3 species are native to North America and 2 to Pennsylvania. The members of thi genus are usually shrubs, rarely trees, found in the northern hemisphere. They do not pro duce wood of any commercial importance, but their fruit, which is a nut, is very common in ou markets. The nuts are sold under the name Hazelnuts or Filberts.

FORM—A shrub or small tree reaching a height of 3-8 feet. Occurs in clumps and ofte forms thickets.

BARK—Rather smooth, thin, dark brown, sometimes roughened with shallow longitudina fissures.

TWIGS—Smooth but marked with a few scattered lenticels, and covered with numerou pinkish hairs which usually stand at right angles to the twigs; gray to russet-brown in colo

BUDS—Alternate, ovate to globular, reddish-brown, somewhat hairy, covered with abou 3-6 scales with hairy and slightly glandular margins.

LEAVES—Alternate, simple, ovate, obtuse or heart-shaped at base, acute at apex, serrate o margin, smooth on upper surface and slightly hairy on lower surface.

LEAF-SCARS—Alternate, semi-circular to globular, raised, with scattered bundle-scars usuall 5-10 in number.

FLOWERS—Appear in April or May before the leaves. Staminate occur in catkins whic usually appear before the leaves at the end of the twigs of the previous season's growth an are from 3-4 inches long. Pistillate small, develop from short scaly buds, with long, slende projecting, crimson stigmas.

FRUIT—A pale brown ovoid nut about ½ of an inch long, slightly flattened, somewhat roughene at base where the involucre is attached. Involucre consists of two leafy bractlets which ar distinct in the Common Hazelnut and united into a tubular beak in the Beaked Hazelnu Ripens in July and August. Kernel sweet and edible.

DISTINGUISHING CHARACTERISTICS—The Hazelnut, also known as American Haz and Filbert, can be recognized by its characteristic fruit, which consists of a nut with leafy involucre of 2 distinct bracts. The closely related Beaked Hazelnut (Corylus rostrata, Ait. has its bracts united and much prolonged into a narrow tubular beak. The young twig are covered with numerous somewhat glandular pinkish hairs. The staminate flowers, occurrin in catkins which develop somewhat in autumn and then remain dormant over winter, ar characteristic. The partially developed staminate aments are often abnormal and twiste due to the attack of some organic agent.

RANGE—Maine and Ontario, south to Florida and Kansas. The Beaked Hazelnut range from Quebec to British Columbia, south to Georgia and Missouri.

DISTRIBUTION IN PENNSYLVANIA—Both species are found locally throughout the Stat

HABITAT—Both species frequent the border of woodlands, hillsides, thickets, and loos stone fences.

IMPORTANCE OF THE SPECIES—These shrubs do not produce any wood of commerci importance, but yield valuable and greatly prized nuts. The nuts are common on ou markets. Both species are very attractive and planted extensively for ornamental purposes.

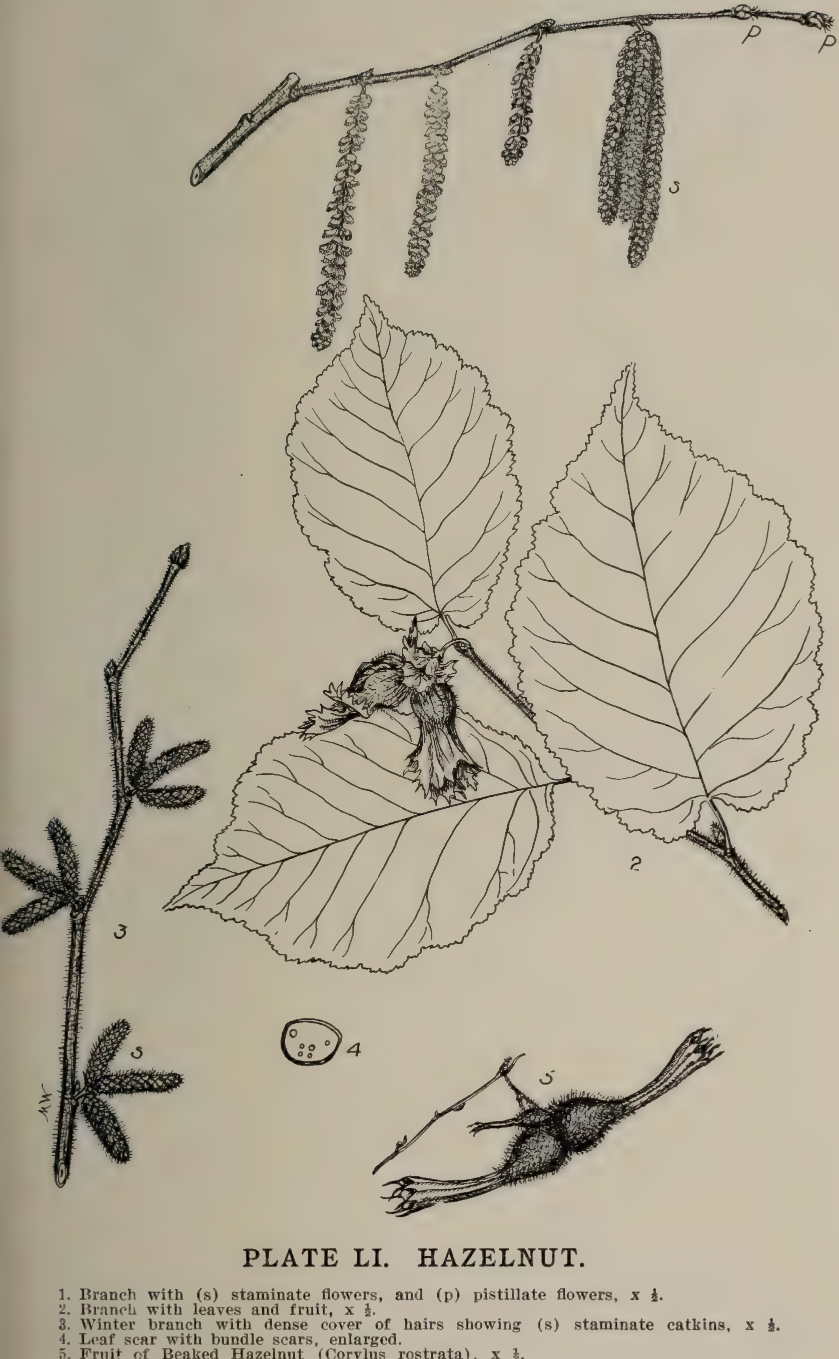

PLATE LI. HAZELNUT.

1. Branch with (s) staminate flowers, and (p) pistillate flowers, x ½.
2. Branch with leaves and fruit, x ½.
3. Winter branch with dense cover of hairs showing (s) staminate catkins, x ½.
4. Leaf scar with bundle scars, enlarged.
5. Fruit of Beaked Hazelnut (Corylus rostrata), x ½.

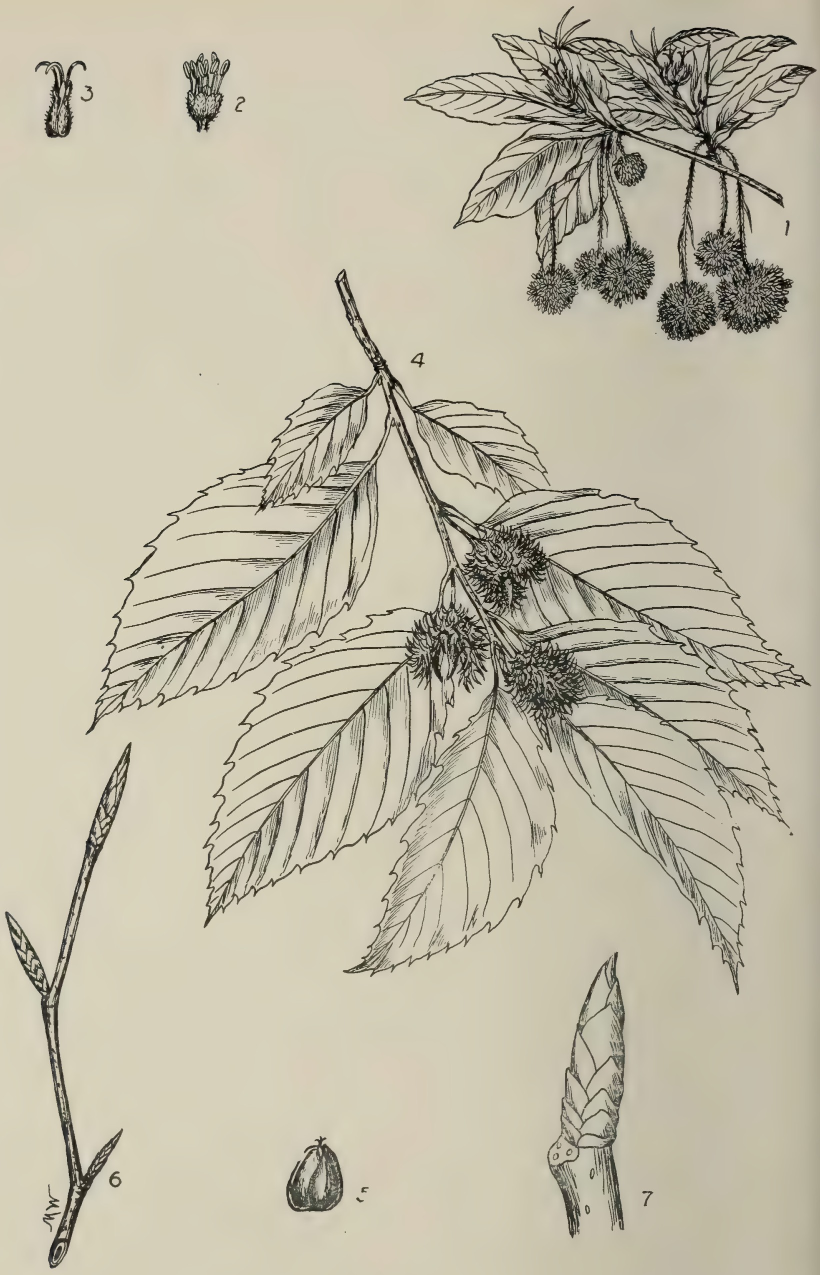

PLATE LII. BEECH.

1. Branch with staminate and pistillate flowers and immature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A branch with mature leaves and three fruits, x ½.
5. A seed, natural size.
6. A winter branch with long, slender, and sharp pointed buds, x ½.
7. Terminal section of a winter branch with long, slender, and sharp pointed bud covered with many overlapping scales, slightly enlarged.

BEECH.

Fagus grandifolia, Ehrhart.

RM—Large tree usually attaining a height of 50-60 ft. with a diameter of 2-3 ft., but reach a height of 125 ft. with a diameter of 4½ feet. Forest grown trees tall, slender, from lateral branches for a considerable distance from the base, with a rather compact llow crown. Open grown trees short-trunked, covered with many lateral branches which often drooping below and erect above, forming a dense, deep, symmetrical crown.

ARK—Very close, smooth, light gray, mottled with dark spots. It invites the cutting nitials and other outline carvings. See Fig. 92.

WIGS—Slender, dark yellow to gray, at first hairy, later smooth, zigzag, covered with owish lenticels, and marked by bud-scale scars.

DS—Alternate; terminal bud present; five times as long as wide, slender, sharp-pointed, cal, usually smooth, covered by 10-20 reddish-brown bud-scales with hairy margins.

EAVES—Alternate, simple, ovate, 3-4 inches long, stiff leathery, with tapering apex and p-toothed margin; light green above, yellowish-green below.

EAF-SCARS—Raised, crescent-shaped to elliptical with a few scattered bundle-scars. ule-scars narrow, almost encircling twig; one end of each stipule-scar is raised above the r end.

OWERS—Appear about April when leaves are one-third developed. Staminate flowers stalked round head about one inch in diameter; pistillate flowers in 2-flowered clusters the axil of the upper leaves.

UIT—A stalked, prickly, 4-valved bur containing triangular pale brown, shining nuts sweet edible kernel.

OOD—Diffuse-porous with minute pores; broad medullary rays present with narrow ones rvening; hard, strong, tough, not durable, difficult to season, light red in color. Weighs 9 lbs. per cubic foot. Used for railroad ties, parquet flooring, novelty wares, carpenter s, fuel, and charcoal.

STINGUISHING CHARACTERISTICS—The American Beech can readily be distinguished by close, smooth, light gray bark, its simple, leathery, often persistent leaves, its prickly stalked fruit with triangular seeds, and its long, slender, conical, sharp-pointed reddish-vn buds.

NGE—Nova Scotia to Ontario and Wisconsin, south to Florida and Texas.

STRIBUTION IN PENNSYLVANIA—Found in every part of the State, but most abundant he northern part. Local in the southeastern and southwestern parts.

ABITAT—Commonly found on rich moist bottom lands, but is also abundant on gravelly es and rich uplands. It endures dense shade and variations of temperature.

IPORTANCE OF THE SPECIES—This species was formerly not of very much commercial ortance, but it is now becoming more important since the process of timber impregnation been developed. It furnishes excellent fuel and in some regions it is now converted into road ties and also manufactured into various by-products on a rather extensive scale. cannot, however, be recommended for extensive planting for forestry purposes but should retained and developed in the farmer's woodlot where the production of fuel is important. the future when more intensive systems of forest management have been developed it be used for underplanting and as a soil conserver.

THE BEECH FAMILY—FAGACEAE.

The Beech family contains some of the most important timber sp cies and has its representatives distributed in nearly all regions the world. The Pine family alone surpasses this one in economic ir portance. It yields not only high grade wood but also food in tl form of nuts, tanning and dyeing materials, and cork. The wood of a high grade and used extensively.

The members of the Beech family have alternate, simple, pinnatel veined, mostly deciduous leaves. A division of the family known the Live Oaks retains its leaves during the winter. The flowe staminate and pistillate, which are rather inconspicuous, are usual yellowish to greenish in color and found on different parts of t same tree and usually on different parts of the same branch. T inconspicuous flowers of this family stand in strong contrast wi the conspicuous flowers of such species as the Magnolias, Cherri Apples, Papaw, and other broad-leaved trees. The fruit consists one or more one-seeded nuts covered by an outer cartilaginous a an inner membranous covering. It is usually heavy and in so species matures in one season while in others it requires two seaso On account of the heavy weight of the seeds they usually fall i mediately below the tree and remain there unless disseminated animals, birds, water, or gravity on slopes. The seed fills the ent cavity of the nut.

This family consists of 6 genera and about 400 species of trees a shrubs of which number 5 genera with about 60 species occur in No America and 3 genera with 19 species in Pennsylvania. The 3 gene not found in Pennsylvania are Castanopsis, Pasania, and Nothofag Representatives of the first 2 genera are found in the western p of the United States, while the genus Nothofagus is confined to southern hemisphere. The subjoined key will distinguish the genera found in Pennsylvania.

KEY TO THE GENERA.

P

1. Staminate aments in globose heads; nuts triangular; buds long, slender, sharp-pointed, conical, 5 times as long as wide, ...Fagus
1. Staminate aments elongated, slender; nuts not triangular; buds shorter, stout, dull-pointed, not 5 times as long as wide, ...2

2. Staminate aments erect or ascending; nuts enclosed in a prickly bur; buds covered with a few overlapping scales, terminal ones absent, ...Castanea
2. Staminate aments drooping; nuts seated in an open scaly cup; buds covered with many overlapping scales and clustered at the terminal end of twig, ...Quercus

BEECH—FAGUS, (Tourn.) L.

This genus comprises trees with a close, smooth and grayish bark, light horizontal spray, simple straight-veined leaves, hard and difise-porous wood and long, slender, conical, sharp-pointed buds. The iembers of this genus are limited to the northern hemisphere with nly 1 native representative in America and 4 in the eastern hemishere. One of the latter is widely distributed in Europe and southestern Asia. It is the Beech which figures in ancient literature nd is now known as the European Beech (Fagus sylvatica L.). his species is now planted extensively for ornamental purposes in merica, especially 3 varieties of it, with purple leaves, cut leaves, nd pendant branches respectively. The wood of the European eech is used extensively in France and Germany for lumber and fuel nd the nuts are used to feed swine. The nuts also yield a valuable il. The other species of the eastern hemisphere are found in eastrn Asia. The description of the sole native American representave, found on page 123, will suffice for the genus.

CHESTNUT—CASTANEA, (Tourn.) Hill.

This genus comprises 5 species of trees and shrubs with furrowed ark, round branchlets without terminal buds, ring-porous wood hich is rich in tannin and durable in contact with the soil. The aves are simple, alternate, stiff, sharp-toothed, and straight-veined. he members of this genus blossom in summer and mature their uit the same autumn at about the time when the first frost apears. The fruit consists of a large spiny bur in which 1-5 nuts are orne. The nuts are highly prized as food. Three species of Chestuts are cultivated in this country for their fruit, the American, the uropean, and the Japanese. The Chestnuts are confined to the orthern hemisphere, both eastern and western. No representatives f this genus are at present found in the western part of North merica, but records show that the Chestnut was at one time indienous to this region. Three species are native in eastern North merica, 2 of which attain tree-size, while 1 (Castanea alnifolia, utt.) seldom exceeds 3 ft. in height and is found in the south tlantic states. The subjoined key will aid in identifying the two pecies native to Pennsylvania.

KEY TO THE SPECIES.

		Page.
1.	Large trees; leaves oblong-lanceolate, smooth and green on both sides; nuts 1-5, usually 2-3, in a bur; buds ¼ of an inch long covered by smooth chestnut-brown scales, ... C. dentata	126
1.	Small trees or shrubs; leaves oblong, whitish downy beneath; nuts rounded, usually one in a bur; buds ⅛ of an inch long, covered by scurfy red scales, ... C. pumila	127

CHESTNUT.

Castanea dentata, (Marshall) Borkhausen.

FORM—A large tree usually attaining a height of 60-80 ft. with a diameter of 3-4 ft., bu may reach a height of over 100 ft. with a diameter of 10 feet. A tree with a diameter of 1 ft. has been recorded from Francis Cove, western North Carolina. Open grown trees hav short trunks with deep, widespreading crowns. Trees in close stands tall, with little ster taper and few lateral branches.

BARK—On old trunks fibrous, deeply fissured; fissures separate somewhat oblique ridge which are covered with dark brown scales. On young trunks and older branches much smoothe See Fig. 82.

TWIGS—Stout, smooth, greenish to brown, round or angular, swollen at the nodes; covere with numerous small, white, raised lenticels. Pith star-shaped.

BUDS—Alternate, axillary; terminal bud absent; ovoid, ¼ of an inch long, sharp to blunt-pointec covered by 2-3 dark chestnut-brown scales.

LEAVES—Alternate, simple, oblong-lanceolate, sharp-pointed at apex, toothed on margir smooth on both lower and upper sides.

LEAF-SCARS—Semi-oval in outline; raised from twig; with numerous, rather inconspicuous scattered, occasionally clustered bundle-scars.

FLOWERS—Appear in June or July. Staminate in crowded clusters along ament; pistillat appear at base of upper aments as globular involucres.

FRUIT—Matures in September or October. A bur covered with numerous, prickly spin and containing 1-5, usually 2-3 nuts.

WOOD—Distinctly ring-porous; with indistinct medullary rays; quite strong in young tree rather weak in older ones; yellowish-brown, very durable, splits easily, rich in tannic aci Weighs 28.07 lbs. per cubic foot. Used for railroad ties, telegraph poles, fence posts, rail cheap furniture, and tannic acid.

DISTINGUISHING CHARACTERISTICS—The Chestnut can readily be distinguished from a other trees except the Chinquapin by its characteristic fruit. See "Distinguishing Characteristics, under Chinquapin, page 127. For Genus Description and Key to Species, see page 125.

RANGE—Maine to Michigan, south to Delaware and along the mountains to Alabama, Mi sissippi, and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Very common in the eastern, southern and centr parts and locally in other parts. It is the most common tree of Pennsylvania.

HABITAT—Grows almost on any kind of soil, from bottom lands to mountain tops, b does not love limestone or extremely wet soil. In the North it is common on glacial dri but in the South it remains close to mountains and reaches its best development in weste North Carolina and eastern Tennessee.

IMPORTANCE OF THE SPECIES—This species, which reproduces itself best by sprout, b also by seed and seedling, is one of the most important commercial species in this Sta It has shown itself to be the surest of all our trees to reproduce a stand fully from sprou It grows fast and is used for many purposes in small as well as large sizes, and thus can managed in short rotation, which insures a certain profit on the investment. A Chestn forest managed for the purpose of producing telegraph poles should be run on rotations about 55 years. On poor soil it may be necessary to increase the length of the rotation. Go tendance reduces the length of the rotation while the absence of it will not only increa the length but also result in an inferior grade of wood. The great variety of uses to whi the wood of this species is put will drain the existing forest to an enormous extent. The is urgent need to reproduce, develop, and improve our existing stands and also to gua against such destructive organic enemies as the Chestnut Bark Disease (Endothia gyrosa va parasitica) commonly known as the Chestnut Blight.

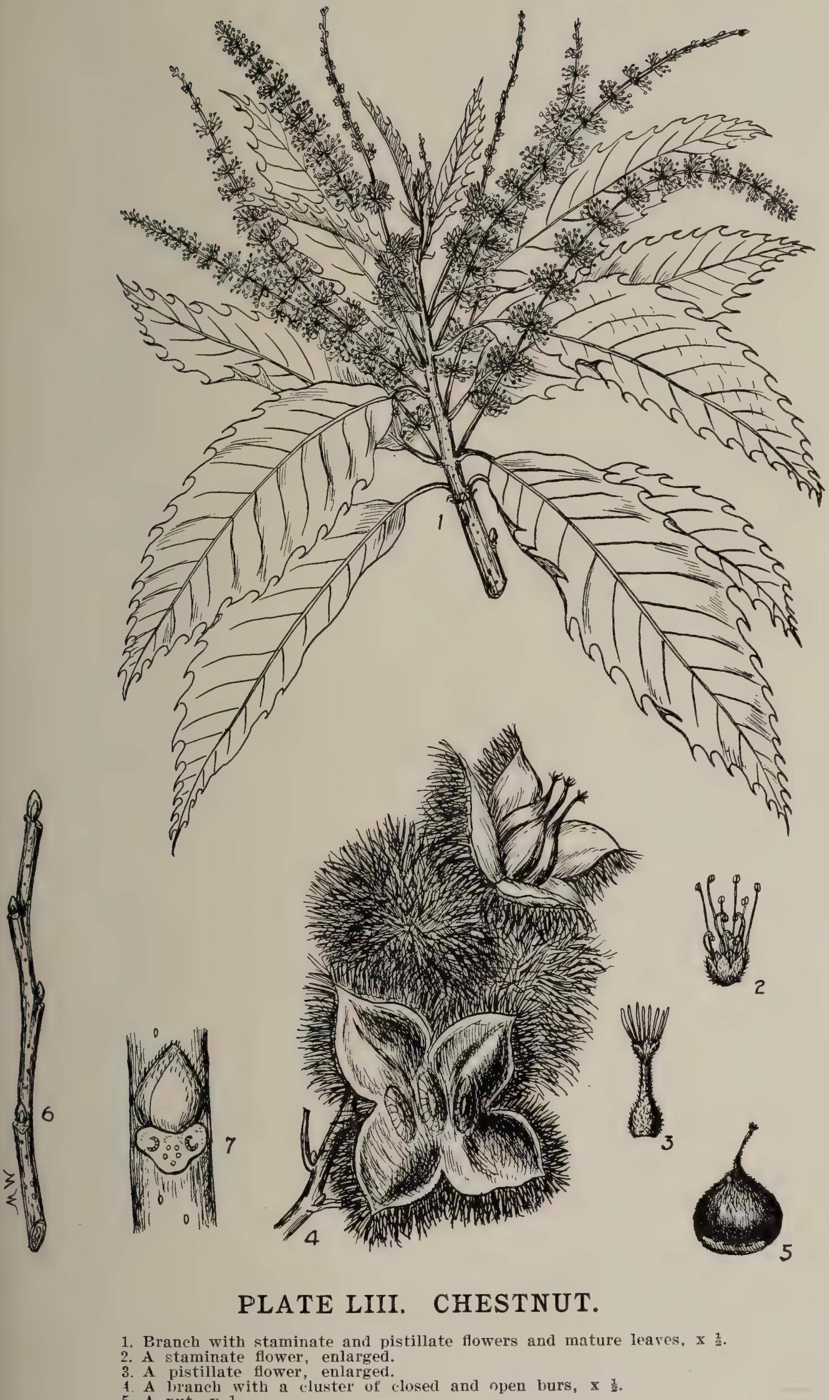

PLATE LIII. CHESTNUT.

1. Branch with staminate and pistillate flowers and mature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A branch with a cluster of closed and open burs, x ½.
5. A nut, x ½.
6. A winter branch, x ½.
7. A section of winter branch, enlarged.

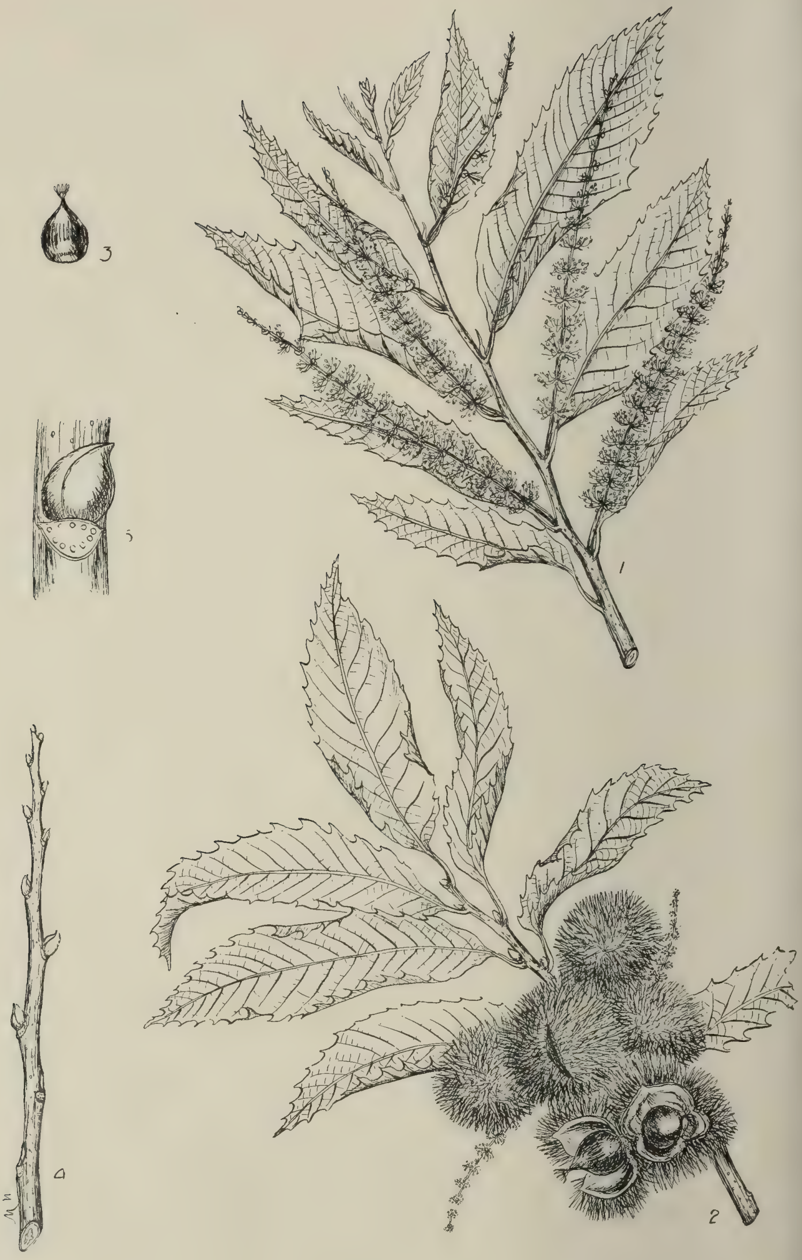

PLATE LIV. CHINQUAPIN.

1. A flowering branch with leaves, x ½.
2. A fruiting branch with mature leaves, x ½
3. A nut, x ½.
4. A winter branch, x ½.
5. A section of winter branch, enlarged.

CHINQUAPIN.

Castanea pumila, (Linnaeus) Miller.

ORM—A small tree or shrub usually attaining a height of 20-30 ft., but may reach a height 50 ft. with a diameter of 3 feet. In Pennsylvania seldom exceeds 20 ft. in height and en is only 3-5 ft. in height. This is the northern limit of its distribution. Trunk usually rt and crown roundish.

ARK—May attain a thickness of one inch, usually fissured and broken into light reddish-wn loose plate-like scales. On branches and young trunks rather smooth, dark grayish-brown.

WIGS—Slender, at first pale woolly, later pubescent, finally smoother, reddish-brown to k brown; covered with numerous lenticels.

UDS—Alternate, axillary; terminal bud absent; ovoid, blunt-pointed, about ⅛ of an inch ; covered with scurfy red scales.

EAVES—Alternate, simple, oblong, thick, firm, straight-veined, sharp-pointed at apex, ply toothed on margin, yellowish-green and smooth on upper surface, pale green and tish-downy beneath.

AF-SCARS—Semi-oval, somewhat raised; with scattered, occasionally clustered, rather nspicuous bundle-scars.

OWERS—Appear in May or June in more or less spreading aments. Staminate occur in ded clusters along ament; pistillate at base of upper aments in ovoid, prickly involucres.

UIT—Matures in September or October. A bur covered with numerous stiff spines and aining usually 1, seldom 2, ovoid bright brown and sweet nuts with a more or less y apex.

OOD—Ring-porous; with indistinct medullary rays; hard, strong, brown, durable, rich annic acid; splits easily. Weighs about 28 lbs. per cubic foot. Used for fence posts, , and railroad ties.

STINGUISHING CHARACTERISTICS—The Chinquapin is a little brother of the Chestnut h one may see by comparing their characteristic fruit. It can be distinguished from the tnut by its smaller size, its whitish down on lower surface of leaf-blades, its smaller fy red buds, and smaller burs containing usually 1 nut.

NGE—New Jersey and Pennsylvania to Florida, Missouri, and Texas.

STRIBUTION IN PENNSYLVANIA—Locally in a few counties in the southern part of the e. Known to occur in the counties of Franklin, Adams, York, Lancaster, and Chester.

BITAT—Usually found on dry, sandy slopes, rather fertile hillsides, and margins of ponds an streams.

PORTANCE OF THE SPECIES—It is of no commercial importance in this State on unt of its small size and its limited distribution. It is very attractive as an ornamental b and yields delicious nuts.

THE OAKS—QUERCUS, (Tourn.) L.

This genus, which consists almost entirely of trees, comprises abou 300 species in the world. The Oaks are world famous on accoun of their wide distribution, physical sturdiness, great strength, an the high commercial value of their wood. Most of them attain great age and are aggressive competitors in the constant struggl which is going on in the forest. They can be reproduced by sprout or by seed, naturally or artificially. Their modesty recommend them from a silvicultural point of view since they will grow in hab tats which are moist or dry, sterile or fertile, cold, temperate o tropical, at low altitudes or at high altitudes up to the timber lin They prefer the temperate climate.

Economically this genus is one of the most important among th trees. Its wood is used extensively and is especially adapted fo high grade work. The bark is rich in tannin, while that of a fe European species is used for cork. The galls which are caused b insect stings are also often rich in tannin. The nuts are used some places as food for man and swine, and occasionally whe roasted form a substitute for coffee.

The leaves are alternate, simple, and usually shed in autumn. division of the Oaks known as the Evergreen or Live Oaks, she the leaves at the end of the second or third season. The flowe staminate and pistillate, appear on different parts of the same tr and often on different parts of the same branch. The staminate male flowers are small and arranged singly on a long slender a drooping ament which emerges from the buds on the twigs of t previous year's growth. The pistillate or female flowers are sma inconspicuous, urn-like bodies which appear singly or in groups fro the base of the developing leaves of the season. The flowers a fertilized by the wind and develop into a nut-like fruit known as acorn. The fruit is distinctive in having a scaly, often bristly c separated from the thin-shelled nut which it partly or almost who encloses. In autumn the nuts may fall to the ground while the cu persist on the tree, or the nut and cup may fall together. The acor may germinate immediately after falling to the ground, b usually they remain dormant until the following spring. T seed-leaves of the nut remain in the shell and furnish nourishme to the developing seedling. A long tap root is characteristic of oak seedling. This makes them difficult to transplant in a nurse or to plant in the place where they are to develop into large tre A large part of the first two seasons' growth of many of our O is concentrated mostly in the development of a root system. T acorns are heavy and disseminated mainly by water, mammals, birds, and gravity on slopes. The fruit of some Oaks matures in one season, while others require two seasons. At the end of the first season the latter appear as immature acorns. The mature fruit of the annual fruiting Oaks is attached to the growth of the season, while that of the biennial fruiting Oaks is attached to last season's growth. During the winter season, immature acorns of the biennial fruiting Oaks are found on the growth of the previous season. The Oaks of Pennsylvania may be classified in two groups:

A. Acorns mature in one season; leaves with rounded lobes, not bristle-pointed; shell of nut usually smooth inside; kernel usually sweet; bark pale often scaly—**WHITE OAKS, ANNUAL OAKS, LEPIDOBALANUS.**

B. Acorns mature in two seasons; leaves or their lobes bristle-pointed; shell or nut usually pubescent inside; bark dark usually furrowed—**BLACK OAKS, BIENNIAL OAKS, ERYTHROBALANUS.**

The subjoined list shows the respective groups to which the several Oaks of Pennsylvania belong.

White Oak group:

1.	**White Oak,**	Quercus alba.
2.	**Swamp Oak,**	Quercus bicolor.
3.	**Post Oak,**	Quercus stellata.
4.	**Chestnut Oak,**	Quercus Prinus.
5.	**Yellow Oak,**	Quercus Muhlenbergii.
6.	**Bur Oak,**	Quercus macrocarpa.
7.	**Chinquapin Oak,**	Quercus prinoides.

Black Oak group:

8.	**Black Oak,**	Quercus velutina.
9.	**Red Oak,**	Quercus rubra.
10.	**Scarlet Oak,**	Quercus coccinea.
11.	**Pin Oak,**	Quercus palustris.
12.	**Spanish Oak,**	Quercus falcata.
13.	**Scrub Oak,**	Quercus ilicifolia.
14.	**Black Jack Oak,**	Quercus marilandica.
15.	**Laurel Oak,**	Quercus imbricaria.
16.	**Willow Oak,**	Quercus phellos.

Of the 300 species of Oaks which are known, about 55 species are native to North America, and 16 species to the State of Pennsylvania. Of the 16 species native to Pennsylvania, 7 belong to the White Oak group and 9 to the Black Oak group. The centre of distribution of this genus is in the mountains of Central America and Mexico. A few species are found in Europe. The subjoined keys will identify the species native to Pennsylvania.

KEY TO THE SPECIES BASED PRIMARILY ON FRUIT AND BUDS.

Page.

1. Acorns maturing at end of second season on last season's growth; immature acorns may be present in winter; shell of nut hairy inside; scales on acorn-cup usually broad and thin, ...2
1. Acorns maturing at end of first season on growth of season; immature acorns never present in winter; shell of nut not hairy inside; scales of acorn-cup more or less knobby, ...10

2. Buds large; terminal ones usually over one-fifth of an inch long, ...3
2. Buds smaller; terminal ones one-fifth of an inch or less in length, ...7

3. Buds coated with rusty brown hairs prominently angled, ...4
3. Buds not coated with rusty brown hairs; not prominently angled, ...5

4. Inner bark yellow; buds ¼-½ of an inch long; acorn-cup top-shaped to hemispheric, Q. velutina 142
4. Inner bark not yellow; buds ¼ of an inch long or less; acorn-cup hemispheric Q. marilandica 145

5. Buds sharp-pointed, ...6
5. Buds blunt-pointed, the widest part, at or just below middle; evidently woolly above middle, ...Q. coccinea. 141

6. Acorn-cups saucer-shaped; buds glabrous except sometimes slightly hairy near apex; bark fissured with intervening broad smooth ridges; branches straight, ...Q. rubra 139
6. Acorn-cups hemispheric; buds light brown and hairy; bark shallowly fissured, with scaly ridges, branching zigzag, ...Q. falcata 143

7. Twigs during first winter dull, finally hairy; shrubs, ...Q. ilicifolia 144
7. Twigs smooth and shining during first winter; trees, ...8

8. Pin-like projections on lateral branches numerous, standing almost at right angles to branch; trunk continuous; acorn-cup saucer-shaped, ...Q. palustris 140
8. Pin-like projections not present; trunk divided, ...9

9. Acorn-cups saucer-shaped; buds dark brown; twigs stouter, ...Q. phellos 147
9. Acorn-cups hemispheric; buds light brown and angular; twigs slender, ..Q. imbricaria 146

10. Buds narrow, conical, sharp-pointed, ¼ of an inch or more in length, ...11
10. Buds obtuse, short, usually about ⅛ of an inch long, ...13

11. Buds pubescent, usually sharp-pointed, lateral buds generally appressed; bark on older twigs with corky ridges; acorn-cups fringed, ...Q. macrocarpa 134
11. Buds smooth, lateral buds divergent; twigs without corky ridges; acorn-cups not fringed, ...12

12. Acorns sessile; twigs slender and hairy to smooth, ...Q. Muhelnbergii 136
12. Acorns evidently stalked; twigs stouter and smooth, ...Q. Prinus 137

13. Bark on branchlets peeling into long, dark, layer-like scales; acorns long stalked, Q. bicolor 135
13. Bark on branchlets not peeling off into long, dark, layer-like scales, ...14

14. Twigs usually coated with yellowish-brown wool; buds about as long as broad, Q. stellata 133
14. Twigs smooth, ...15

15. Twigs slender; shrub or small tree; buds about as long as broad; acorn-cup encloses ½ of nut, ...Q. prinoides 138
15. Twigs stout; large tree; buds longer than broad; acorn-cup encloses ¼ of nut, ..Q. alba 132

KEY TO THE SPECIES BASED PRIMARILY ON LEAVES AND FRUIT.

Page.

1. Leaf-blades or their lobes bristle-tipped; acorns maturing at end of the second season; nuts often pubescent within, ...2
1. Leaf-blades or their lobes or teeth without bristle tips; acorns maturing at end of the first season; nuts often glabrous within, ...10

2. Leaf-blades entire; rarely lobed or toothed except on vigorous coppice shoots, ...3
2. Leaf-blades pinnatifid, pinnately-lobed or dilated at apex, ...4

3. Lower surface of leaf-blades glabrous, ...Q. phellos 147
3. Lower surface of leaf-blades pubescent, ...Q. imbricaria 146

4. Leaf-blades pinnatifid or pinnately-lobed, ...5
4. Leaf-blades dilated at apex; obovate brown tomentose on lower surface, Q. marilandica 145

5. Leaf-blades green on both upper and lower surfaces, ...6
5. Leaf-blades pubescent on lower surface, ...8

6. Lobes of leaf-blades about equal the width of the middle portion or body of the leaf, ...Q. rubra 139
6. Lobes of leaf-blades 2-6 times as long as the breadth of the narrowest portion or body of the leaf, ...7

7. Trunk continuous, covered by short, slender, often horizontal lateral branches; acorn-cups saucer-shaped, ...Q. palustris 140
7. Trunk usually branched; covered by rather long, usually stout and ascending lateral branches; acorn-cups top-shaped, ...Q. coccinea. 141

8. Leaf-blades brown or rusty pubescent on lower surface; inner bark yellow, Q. velutina. 142
8. Leaf-blades gray or white pubescent on lower surface; inner bark not yellow, ...9

9. Lobes of leaf-blades long and lanceolate, often scythe-shaped; large tree, ...Q. falcata 143
9. Lobes of leaf-blades short and triangular, usually five in number; small tree or shrub, ...Q. ilicifolia 144

10. Leaf-blades deeply lobed, ...11
10. Leaf-blades coarsely toothed, ...13

11. Mature leaf-blades glabrous and pale on lower surface; cups shallow, ...Q. alba 132
11. Mature leaf-blades pubescent on lower surface; cup encloses at least one-third of nut, ...12

12. Mature leaf-blades rusty-pubescent below; leaves usually 5-lobed; stellate pubescent above with three terminal large rounded or squarish lobes; upper scales of acorn-cup not awned, ...Q. stellata 133
12. Mature leaf-blades white tomentose beneath; leaves usually 5-7-lobed with single large oval and crenate terminal lobe; upper scales of acorn-cup awned with a heavy fringe, ...Q. macrocarpa 134

13. Leaf-blades broadest at or below the middle, oblong to lanceolate, decidedly pointed at apex, usually exceeding six inches in length, ...14
13. Leaf-blades broadest above the middle, oblong to oblong obovate, pointed to rounded at apex, seldom exceeding six inches in length, ...15

14. Leaf-blades with acuminate apex; slender petiole; acorn sessile, ...Q. Muhlenbergii 136
14. Leaf-blades with acute apex; stouter petiole; acorn stalked, ...Q. Prinus. 137

15. Tall tree; bark on small branches often peeling off in dark scales; acorns long-stalked, ...Q. bicolor 135
15. Shrub or small tree; bark on small branches smooth; acorn sessile, ...Q. prinoides 138

WHITE OAK.

Quercus alba, Linnaeus.

FORM—A very large and valuable tree, usually attaining height of 70-80 ft. but may reach a maximum height of 140 ft. with a diameter of 8 ft. when grown in a closed stand. When grown in a dense stand (Fig. 11) it has a clean continuous trunk often free from lateral branches for 75 ft. with a diameter of 5 ft., and little stem taper. When grown in the open (Fig. 21) it divides near the ground into a great many lateral branches which are gnarled and twisted forming a deep, wide, and irregular crown or occasionally a symmetrical crown. Open grown trees produce a very small quantity of timber of commercial importance.

BARK—On smaller branches light green to reddish-green; on mature trunks up to 2 inches thick, usually light gray or white, shallowly fissured into flat, irregular scales often very loosely attached. Occasionally the bark of trunk appears roughly ridged and without scales. See Fig. 73.

TWIGS—During first summer light green, tinged with red, coated with loose, pale hairs. First winter slender, smooth, reddish to gray, covered with numerous, light, minute, elevated lenticels. Pith star-shaped.

BUDS—Alternate; terminal buds clustered; broadly ovate, obtuse, reddish-brown, ⅛ of an inch long.

LEAVES—Alternate, simple, 5-9 inches long, 2-4 inches wide, obovate in outline, with 3-9, but usually 7 ascending lobes; lobes blunt at apex and separated by deep round-based sinuses. When full grown thin, bright green and smooth above, and pale, smooth, and occasionally glaucous below.

LEAF-SCARS—Alternate, raised, concave to round above, rounded below. A decurrent ridge often continues from raised leaf-scar which makes the twig 5-angled on account of 5-ranked arrangement of leaf-scars. Bundle-scars are numerous, scattered, inconspicuous. The leaf-scars of the Oaks of this State so closely resemble each other that a description of a leaf-scar of one species will suffice for all.

FLOWERS—Flowers appear in May when the leaves are about ⅓ developed. Staminate flowers are borne in hairy aments 2½-3 inches long. Calyx is very hairy and yellow. Stamens extend beyond calyx. Anthers are yellow and notched. Pistillate flowers are borne on short stalks, with hairy involucral scales and red spreading styles.

FRUIT—An acorn, maturing during one season, sessile or short-stalked. Nut ovoid, rounded at apex, shiny, light brown, ¾ of an inch long, inclosed for ¼ length in cup. Meat of nut is sweet and edible. Cup bowl-shaped, slightly tomentose on inside, covered with numerous scales which are thin, short, flat, blunt-pointed near rim, thickened and knobby near the base.

WOOD—Ring-porous; with very conspicuous medullary rays; strong, heavy, hard, close-grained, durable in contact with soil, light brown with lighter sapwood. The most valuable of all oak wood. Weighs 46.35 lbs per cubic foot. Used in construction, ship building, tight cooperage, furniture, railroad ties, manufacture of wagons, agricultural implements, interior finish of houses, fences and fuel.

DISTINGUISHING CHARACTERISTICS—In summer one can distinguish the White Oak very readily by its loose scaly, grayish or white bark from which it takes its common name, and by its deeply round-lobed leaves with a smooth and pale lower surface when mature. In winter it has some characteristics apparently in common with some other Oaks but can be distinguished from the Red, Black, Scarlet, Chestnut, and Yellow Oaks by its obtuse, rather small buds; from the Swamp White Oak by the slender reddish to grayish twigs and the absence of dark loose peeling flakes on the branches; from the Post Oak by the absence of greenish rusty pubescence on the twigs; from the Pin Oak by the absence of stiff lateral pins on the branches and the more obtuse buds; from the Bur Oak by the absence of corky wings on the branches. In addition to these characteristics the acorns and leaves which often persist will aid considerably in recognizing the different species. A careful study of the key to the species will help in bringing out additional distinguishing characteristics.

RANGE—Maine to Minnesota, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Abundant throughout the eastern, central, and southern parts, and rather common at least locally, in the northern and western parts.

HABITAT—It is tolerant of many soils, growing on sandy plains, gravelly ridges, rich uplands, and moist bottomlands. It reaches its best development in rich moist soil.

IMPORTANCE OF THE SPECIES—The White Oak is the most important hardwood species of Pennsyvania. It is a slow grower but develops an exceptionally high grade material. Artificial regeneration by planting is difficult. Sprouting cannot be depended upon. Natural seed regeneration is the best method by which this species can be successfully reproduced. German experimentation has shown conclusively that the natural method is superior to the artificial, especially with Oak. The great value of its timber will justify attempts to grow this species in forest stands of considerable extent.

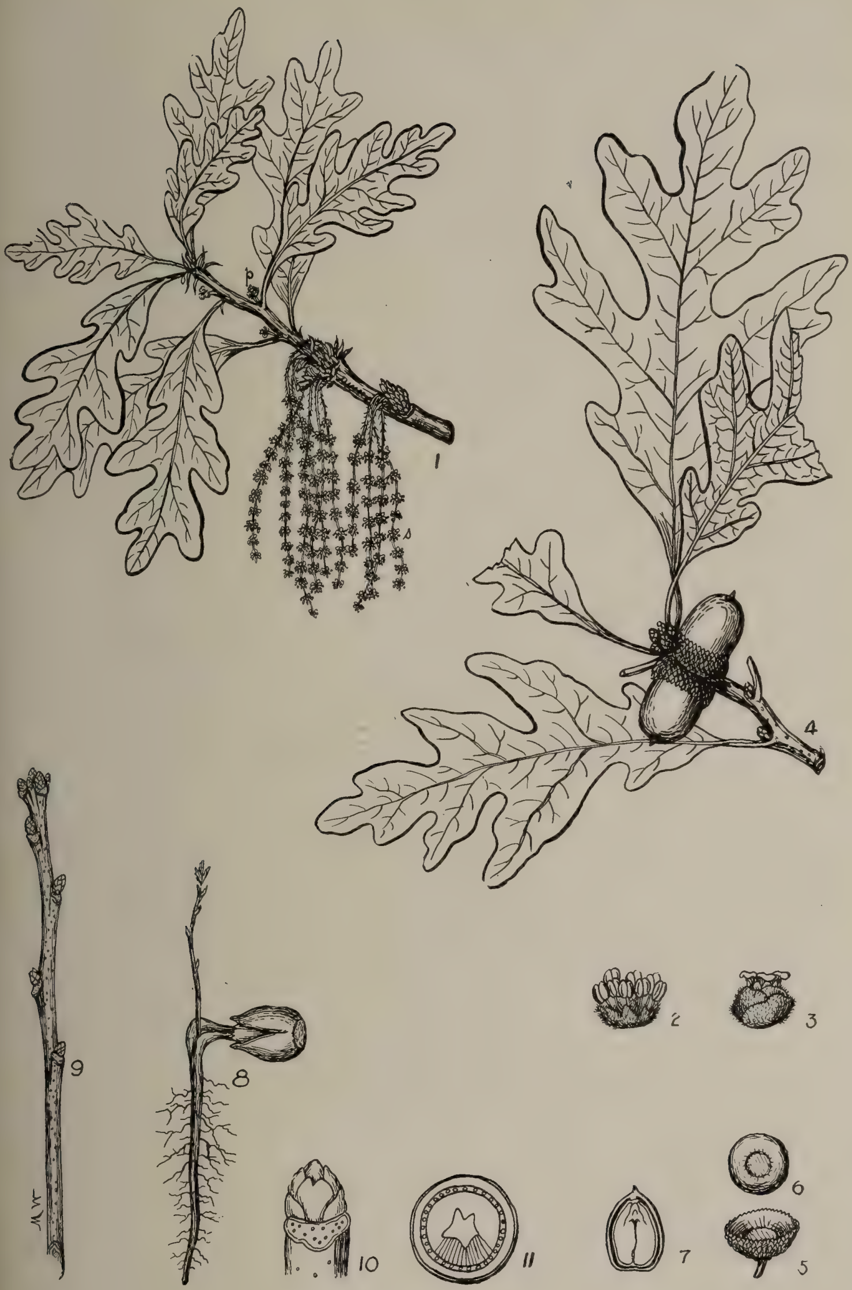

PLATE LV. WHITE OAK.

1. Flowering branch with immature leaves (s) staminate blossoms, (p) pistillate blossoms, x ⅓.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. Branch with mature leaves and mature acorns, x ½.
5. Acorn cup, x ½.
6. Acorn, basal view, x ⅓.
7. Longitudinal section of acorn showing embryo, x ½.
8. Germinating acorn with its young root and shoot, x ½.
9. Winter branch, x ½.
10. Terminal section of winter branch showing bud with overlapping scales, a leaf-scar with bundle-scars, and lenticels, enlarged.
11. Cross section of twig showing pentangular pith, wood with conspicuous medullary rays, inner and outer bark, enlarged.

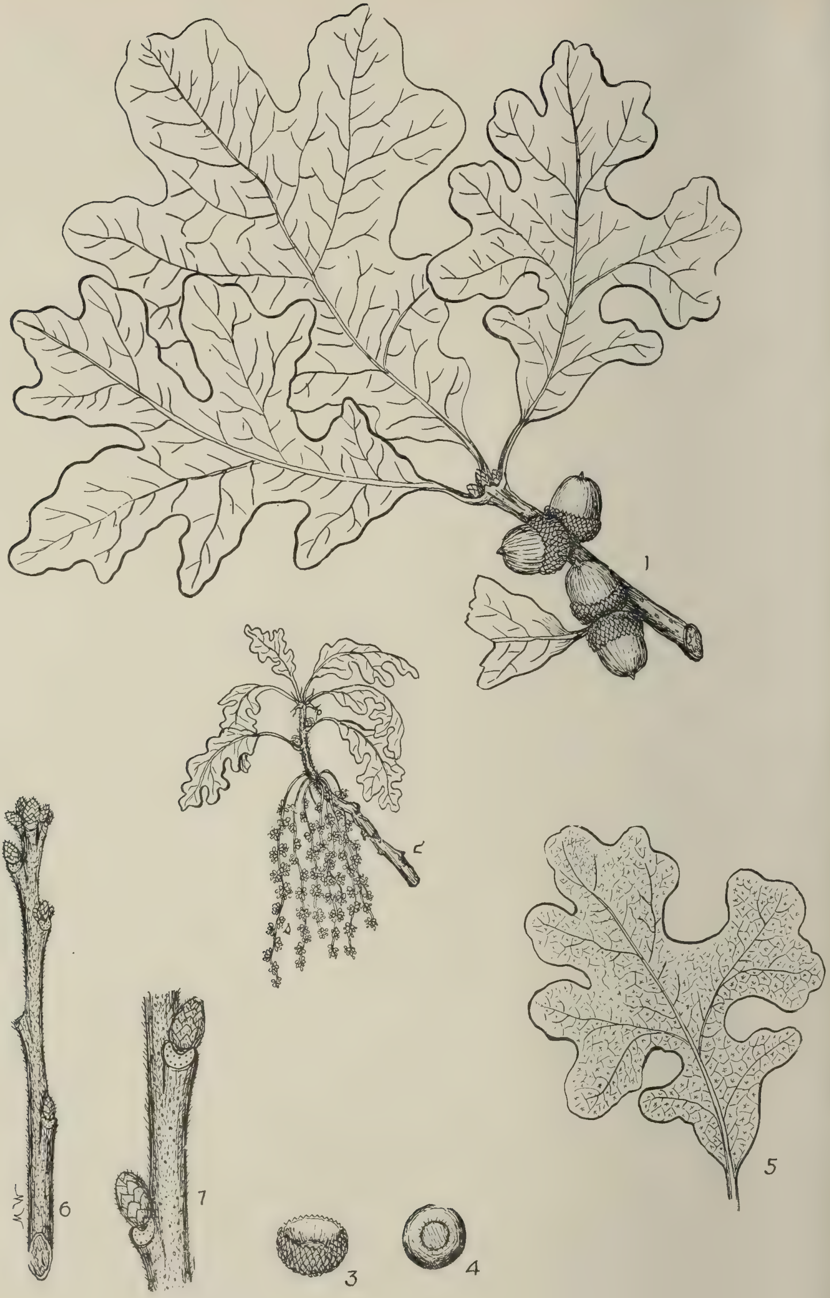

PLATE LVI. POST OAK.

1. Branch with mature leaves and mature acorns, x ½.
2. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
3. An acorn cup, x ½.
4. An acorn, basal view, x ½.
5. Lower surface view of mature leaf showing the dense star-shaped pubescence, x ½.
6. Winter branch covered with a dense rusty pubescence, x ½.
7. Section of winter branch showing slightly pubescent buds, leaf-scars with bundle-scars, lenticels. and the dense rusty pubescent bark, natural size.

POST OAK.

Quercus stellata, Wangenheim.

FORM—A medium-sized tree, usually attaining height of 50-60 ft. but may reach a maximum height of 90 ft. with a diameter of 4 feet. In the open it forms a dense, broad, deep, round-topped crown with stout and spreading branches. Toward its northern limit it is a large shrub.

BARK—On trunks somewhat similar to that of White Oak only darker and often rougher and less scaly. On young branches it is often covered with loose, dark scales.

TWIGS—Stout, covered with yellowish rusty pubescence, at first light orange in color, later dark brown. Season's growth stands in strong contrast with later growth on account of much lighter color. Pubescence soon turns dark and finally disappears.

BUDS—Alternate, broadly ovate, about ⅛ of an inch long, sometimes as broad as long, blunt-pointed, covered with numerous overlapping, reddish-brown, slightly pubescent scales.

LEAVES—Alternate, simple, obovate in outline, 4-7 inches long, 3-5 inches wide, thick, leathery, generally 5-lobed; the middle pair of lobes is the largest and is separated by deep sinuses; upper surface of leaf is bright green, shiny; lower surface is paler and coated with rusty pubescence.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May. Staminate borne in slender aments 4-6 inches long. Pistillate sessile or short-stalked, woolly; stigmas bright red.

FRUIT—An acorn, maturing at end of first season; usually sessile, occurs solitary, in pairs or clustered. Nut oval, ½-¾ of an inch long, hairy at apex, longitudinally striped with darker brown, inclosed by cup for ⅓-½ of its length. Cup thin, hairy within, and covered with thin, pale, flat woolly scales.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, hard, close-grained, very durable, light to dark brown, with light sapwood. Weighs 52.14 lbs. per cubic foot. Used for the same purposes as White Oak. It is found on the market mixed with White Oak.

DISTINGUISHING CHARACTERISTICS—In summer the Post Oak, also known as Iron Oak, may at once be recognized by the peculiar form of its leaves, with large rounded or squarish lobes. The three terminal lobes are the largest and the basal lobes taken together are wedge-shaped in outline. The rigid leathery leaves with their shiny green upper surface and rusty pubescent lower surface, and the rusty pubescent twigs are characteristic. In winter its short obtuse buds and stout rusty pubescent twigs are distinctive. The buds have also a brighter reddish color than those of the White Oak.

RANGE—Massachusetts, central Pennsylvania, Kansas, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally in the eastern and southern parts, but not in the western and northern.

HABITAT—Common on dry rocky soil. Found on gravelly uplands, limestone hills, and sandy plains.

IMPORTANCE OF THE SPECIES—The Post Oak closely resembles the White Oak, especially in the wood, which is sold as White Oak. On account of its limited distribution in Pennsylvania, and the superiority of the White Oak, this species cannot be recommended for forestry purposes on an extensive scale. It will, however, grow on poorer soil than the White Oak and might be established upon such areas. It is difficult to transplant and grows slowly.

BUR OAK.

Quercus macrocarpa, Michaux.

FORM—Usually attains height of about 70-80 feet but may reach a maximum height of 170 feet with a diameter of 6-7 feet. It attains its greatest height in Illinois and Indiana. It has broad spreading branches which form a broad round-topped crown. In the forest the crown is usually contracted and covers only the upper part of the trunk. It is a giant among its associates.

BARK—Intermediate between flaky bark of White Oak and very roughly ridged bark of Chestnut Oak.

TWIGS—Stout, covered with pale, raised and inconspicuous lenticels, yellowish-brown, at first hairy, later smooth, with corky wings often 1½ inches wide.

BUDS—Alternate, broadly-ovate, about ¼ of an inch long, acute or obtuse, reddish-brown, slightly pubescent. Lateral buds are closely appressed.

LEAVES—Alternate, simple, 6-12 inches long, 3-6 inches wide, obovate or oblong; 5-7 lobed; sinuses round-based; terminal lobe largest; smooth, shiny, and dark green above; paler and finely hairy beneath.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Mature about May. Staminate flowers borne in slender ament 4-6 inches long. Pistillate sessile or short-stalked, with bright red stigmas and hairy scales.

FRUIT—An acorn, maturing during first season; sessile or stalked, usually solitary. Nut ovate, 4/5—2 inches long, covered with down. Cup deep, embracing from ½ to entire nut, light brown, downy on inner side, covered with large imbricated scales forming a distinct fringe near the margin.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, hard, strong, close-grained, very durable, brownish with light thin sapwood. Weighs 46.45 lbs. per cubic foot. Used for the same purposes as White Oak from which it is not distinguished on the market.

DISTINGUISHING CHARACTERISTICS—In summer the Bur Oak, also known as Over-cup or Mossy-cup Oak, can be distinguished by its unique leaves, which have deep, rounded sinuses that reach almost to the midrib and divide each side of a leaf almost into two parts. The lobes on the front part are rather squarish and those on the basal part triangular. The pubescence on the lower side of the leaves and the corky winged projections on the branches are also characteristic. In winter the corky winged projections on the branches, the closely appressed and pubescent buds, the distinctly fringed acorn cups, and the persistent leaves are characteristic.

RANGE—Nova Scotia to Manitoba, south to Pennsylvania, Kansas and Texas.

DISTRIBUTION IN PENNSYLVANIA—Rare or local in the eastern, southern, and western parts of the State. Not reported from other parts.

HABITAT—Prefers low rich bottomlands but can grow upon a variety of soils. It does not thrive on uplands so well as the White Oak, grows much slower than the Red Oak, and is rather intolerant of shade.

IMPORTANCE OF THE SPECIES—It is one of the very largest of American Oaks, has a wide distribution, and occurs in pure and in mixed stands. This species produces valuable wood especially adapted to quarter-sawing on account of conspicuous medullary rays. It should be regenerated especially in the Mississippi basin where it develops at its optimum. This tree is also very attractive as an ornamental or shade tree, since it withstands smoke more than most other Oaks, and is relatively free from disease.

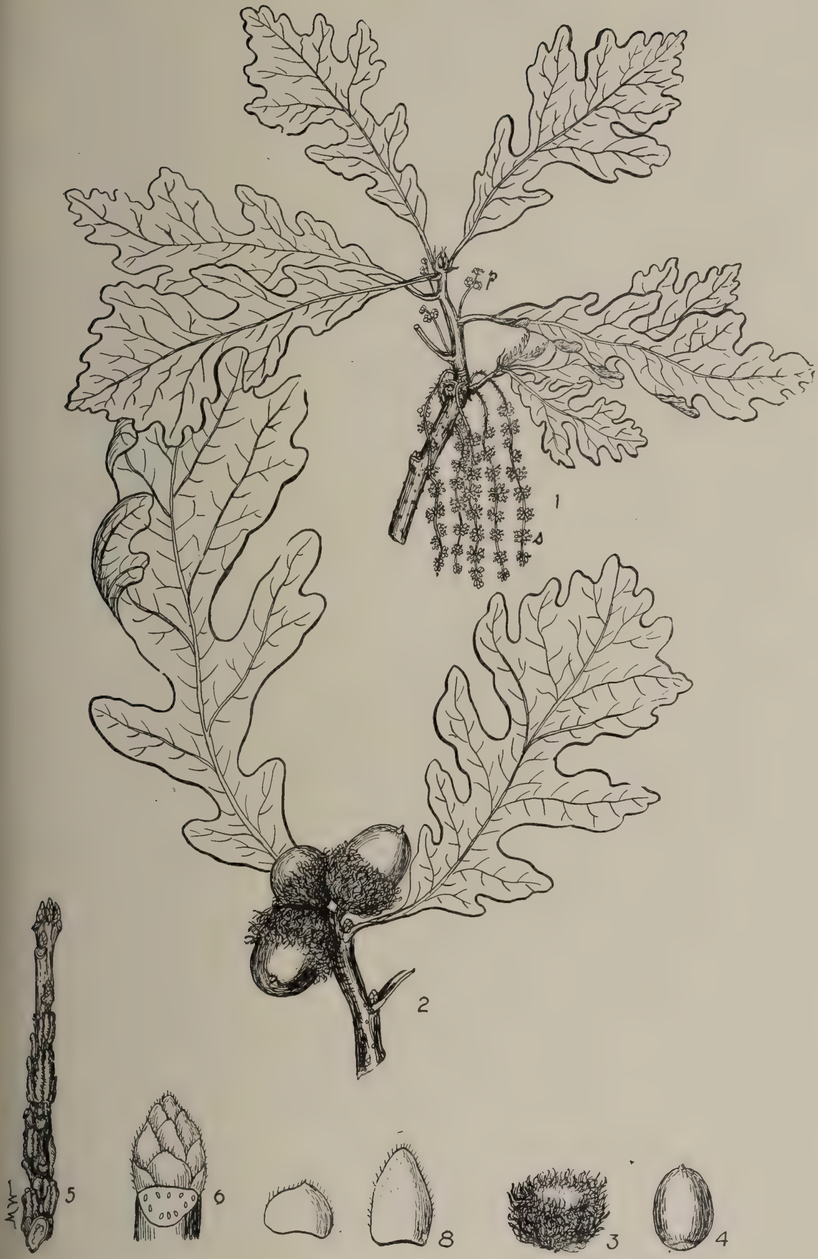

PLATE LVII. BUR OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ⅓.
2. Branch with mature leaves and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ⅓.
5. A winter branch showing buds, leaf-scars, and raised corky ridges, x ½.
6. Terminal section of winter branch showing bud with overlapping scales and leaf-scar with bundle-scars, enlarged.
7. Basal bud-scale with hairy margin, enlarged.
8. Apical bud-scale with hairy serrate margin, enlarged.

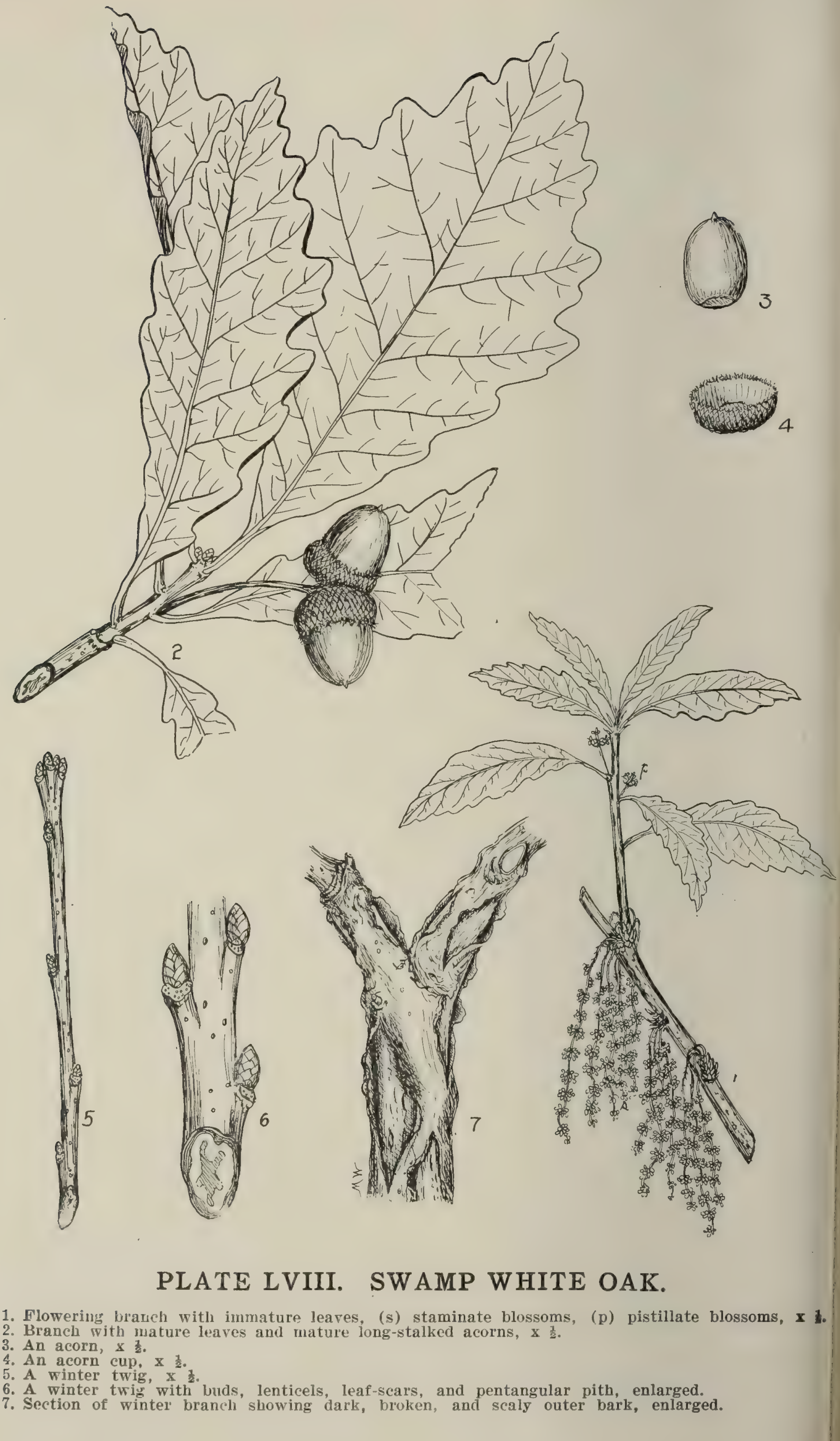

PLATE LVIII. SWAMP WHITE OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves and mature long-stalked acorns, x ½.
3. An acorn, x ½.
4. An acorn cup, x ½.
5. A winter twig, x ½.
6. A winter twig with buds, lenticels, leaf-scars, and pentangular pith, enlarged.
7. Section of winter branch showing dark, broken, and scaly outer bark, enlarged.

SWAMP WHITE OAK.

Quercus bicolor, Willdenow.

FORM—An average-sized tree usually attaining a height of 60-70 ft., occasionally attaining a height of 100 ft. with a diameter of 3 feet. In the open it develops a broad, open, round-topped crown with the upper branches ascending, the lower often drooping. Scraggy and peeling branches make it rather unattractive. In dense stands the trunk is clean and continuous.

BARK—On young branches reddish-brown, smooth, soon becoming rough and unkempt by peeling into long, persistent, dark scales and exposing light inner bark. On old trunks thick, grayish-brown, deeply fissured into long, often continuous, flat ridges which break up into small gray scales. See Fig. 77.

TWIGS—Stout, yellowish to reddish-brown, usually smooth, covered with pale raised lenticels; pith star-shaped.

BUDS—Alternate, broadly ovate, obtuse, ⅛-¼ of an inch long, covered with light chestnut-brown scales, often slightly hairy towards the apex.

LEAVES—Alternate, simple, usually obovate in outline, 5-6 inches long, 2-4 inches wide, rounded at narrowed apex, coarsely dentate on margin, with shallow rounded lobes; upper surface shining dark yellowish-green; lower surface light green and finely hairy.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flowers occur in hairy aments 4-5 inches long. Pistillate are borne on short-stalks, either solitary or few in a cluster.

FRUIT—An acorn, maturing during one season, solitary or few in a cluster, usually borne on a long stalk. Nut oblong, ¾-1¼ inches long, chestnut-brown, usually hairy at apex. Cup deeply saucer-shaped, thick, enclosing ⅓ of nut, hairy inside, covered with pale woolly scales which are rather thickened near base, and thin, narrow, often fringed at margin.

WOOD—Diffuse-porous; with rather conspicuous medullary rays. It possesses the same physical characteristics as the White Oak, and is sold on the market as White Oak. Weighs 47.75 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Swamp White Oak can be distinguished from all other Oaks at any season of the year by the bark on the younger branches which peels off into thin large plates as in the Buttonwood tree. In summer this species can be recognized by the leaves which have shallow sinuses between the lobes, giving the leaf a broad effect. In fall the long-stalked acorns with their cups enclosing about ⅓ of nut are characteristic. In winter the rather stout, yellowish to reddish-brown twigs bearing buds with light chestnut-brown scales and the irregular, often drooping, growth of the lower lateral branches is peculiar to this species.

RANGE—Maine and Quebec to Michigan, south to Georgia and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Reported from eight counties in the eastern and southern parts of the State, one in the western part, and common in the northwestern.

HABITAT—Frequents rich soils on borders of swamps and streams.

IMPORTANCE OF THE SPECIES—The Swamp White Oak is an important tree but its propagation should not be recommended or attempted where the White Oak will grow. Its lateral branches have a tendency to persist which results in an inferior grade of lumber. It has no ornamental qualities which especially recommend it for such planting.

YELLOW OAK.

Quercus Muhlenbergii, Engelmann.

FORM—An average-sized tree usually attaining a height of 40-50 ft., but occasionally may reach a height of 160 ft., with a diameter of 3-4 feet. Rather stunted in growth in the northeastern part of its distribution and attains its maximum development along the Wabash river in Indiana and Illinois. Lateral branches are relatively small forming a narrow, often shallow, round-topped head. Trunk often widely buttressed at base.

BARK—Thick, rough, close, fissured into long, irregular ridges which break up into grayish to brownish scales.

TWIGS—Slender, reddish-brown to grayish-brown, at first hairy becoming smooth, longitudinally ridged, covered with pale lenticels; pith star-shaped.

BUDS—Ovoid, sharp-pointed, about 1/6 of an inch long, covered by numerous overlapping, light chestnut-brown scales which are slightly hairy along margin. The buds show a general resemblance to those of the Chestnut Oak only are smaller.

LEAVES—Resemble those of the Chestnut Oak but have a more acuminate apex; also resemble those of the common Chestnut with incurved teeth.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flowers occur in hairy aments, 3-4 inches long. Pistillate flowers sessile or short-stalked with bright red stigmas.

FRUIT—An acorn, maturing during one season, usually sessile, occasionally short-stalked. **Nut** ovoid, ½-1 inch long, pubescent at apex, light chestnut-brown. **Cup** thin, encloses about ½ of nut, covered by pale brown woolly scales with thickened bases and thin tips often forming a fringe along the margin.

WOOD—Diffuse-porous; with less prominent medullary rays than most Oaks; heavy, hard, strong, durable in contact with soil. A distinct difference between spring and summer wood. Used for same purposes as White Oak except for tight cooperage and cabinet work, because it checks very badly. Weighs 53.63 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Yellow Oak, also known as Chinquapin Oak, can be distinguished from the Chestnut Oak by its usually sessile and smaller acorns, smaller buds, more acuminate leaves, and flaky gray bark. It can also be distinguished from the Dwarf Chinquapin Oak by its larger size, sharp-pointed buds, larger and sharper-pointed leaves, and the absence of gray blotches on the bark of the young trunks.

RANGE—Vermont to Minnesota, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Rare. Found locally in the southeastern and southern parts.

HABITAT—Usually found on dry ridges, especially upon limestone soil.

IMPORTANCE OF THE SPECIES—The wood of this species is not equal to that of the White Oak and in addition it grows slower. In all localities where both grow the White Oak should be favored, while in localities where the White Oak is absent this Oak might be propagated. It is a beautiful tree and should be planted extensively in parks and lawns on account of its handsome form and attractive foliage.

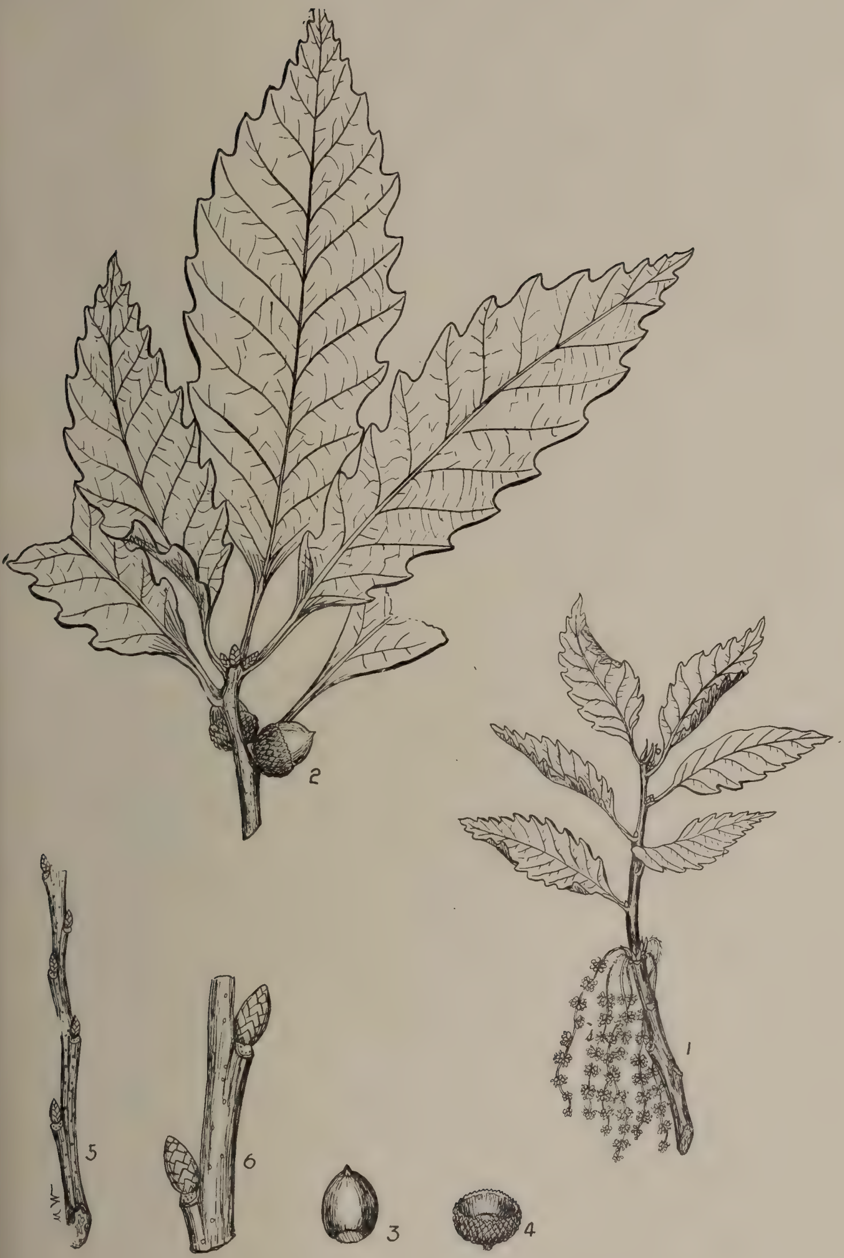

PLATE LIX. YELLOW OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves and mature acorns, x ½.
3. An acorn, x ½.
4. An acorn cup, x ½.
5. Terminal section of winter twig, x ½.
6. Section of winter twig showing buds, lenticels, and leaf-scars with bundle-scars, enlarged.

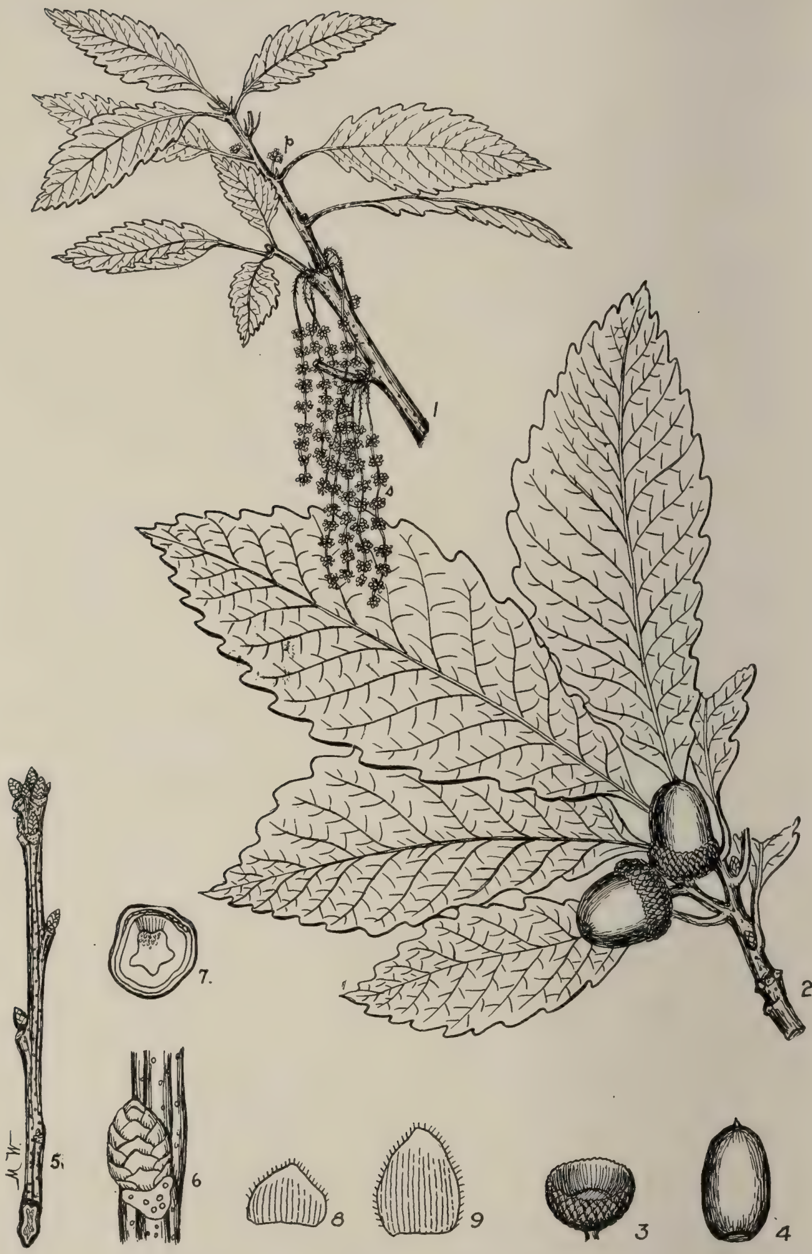

PLATE LX. CHESTNUT OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ⅓.
2. Branch with mature leaves and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. A winter twig showing buds, lenticels, leaf-scars, fluted bark, and pentangular pith, x ½.
6. Section of a winter twig, enlarged.
7. Cross section of a twig showing pentangular pith, wood with conspicuous medullary rays, inner and outer bark, enlarged.
8. A basal bud-scale with hairy margin, enlarged.
9. An apical bud-scale with hairy margin, enlarged.

CHESTNUT OAK.

Quercus Prinus, Linnaeus.

FORM—A medium-sized tree usually attaining a height of 60-70 ft., occasionally 100 ft., with a diameter 6-7 feet. In dense stands the trunk is straight and continuous while in open stands it is low and divided, forming a very broad open crown.

BARK—On young stems and smaller branches smooth, thin, yellowish-brown. On older branches and trunk rough, thick, brown to black, rich in tannin, divided into long, broad and continuous fissures. Ridges are very solid, sharp-angled, not scaly. Base of the fissures often cinnamon-red, especially on the larger branches and smaller trunks. See Fig. 75.

TWIGS—First summer greenish-purple; first winter orange or reddish-brown; stout, smooth; bitter; with inconspicuous lenticels and star-shaped pith.

BUDS—Alternate, ovate-conical, distinctly sharp-pointed, ¼-½ of an inch long. Bud-scales light chestnut-brown, imbricated, slightly hairy towards apex and along margin.

LEAVES—Alternate, simple, obovate, thick, stiff, 5-9 inches long, 2-4 inches wide, usually wedge-shaped at base, coarsely dentate with rounded teeth on margin; green and smooth on upper leaf-surface, pale green and at first hairy on lower.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flowers are yellow and borne in hairy aments 2-3 inches long. Pistillate flowers have a short divergent, reddish style, and occur in small groups upon stout stalks.

FRUIT—Solitary or in pairs; matures in one season on short stalks. Nut 4/5-1½ inches long, 2-3 times as long as broad, smooth, glossy, oval, chestnut-brown, acute or round-pointed, and contains a sweet kernel. Cup thin, deep, hemispheric, covers ⅓ of nut, hairy inside. Scales of cup are thin-tipped, reddish-brown, rather knobby near the base.

WOOD—Ring-porous; with prominent medullary rays; heavy, strong, close-grained, durable in contact with soil, dark brown with lighter sapwood. Weighs 46.73 lbs. per cubic foot. Used for railroad ties, fencing, fuel and construction. Ranks close to White Oak.

DISTINGUISHING CHARACTERISTICS—In summer the Chestnut Oak, also known as Rock Oak, can be distinguished by its oblong leaves margined with course rounded teeth and the roughly fissured and non-scaly bark. In winter one can readily recognize it by its characteristic bark, its sharp-pointed conical buds and its distinctive fruit. The persistent leaves often aid in recognizing it in winter, as well as the absence of 1-year old developing acorns. The slender, angular, orange-brown twigs terminated by a cluster of light brown sharp-pointed buds with a slight apical pubescence will always determine this species with certainty.

RANGE—Maine to Ontario, south to Alabama and Tennessee.

DISTRIBUTION IN PENNSYLVANIA—Common in the mountainous region of the State. Locally it becomes a prevailing tree.

HABITAT—Usually found on dry hillsides and towards the south in the mountains. It reaches its best development in the mountains of western North Carolina, eastern Tennessee and Kentucky upon rich moist soil. It is light-demanding and unless crowded will develop often into a crooked tree.

IMPORTANCE OF THE SPECIES—The Chestnut Oak belongs to the White Oak group. Its wood is used practically for the same purposes as that of the White Oak. The wood is valuable and in addition the bark is very valuable because it is richer in tannin than that of any other Oak. Large quantities of this bark are harvested annually at the present time in the southern Appalachians. This species deserves to be regenerated extensively, especially by natural seed regeneration methods and admixed with the well known Chestnut. In case of artificial regeneration it may be advisable to sow the seeds rather than plant seedlings since this species is rather sensitive to transplanting.

SCRUB CHESTNUT OAK.

Quercus prinoides, Willdenow.

FORM—Usually a low shrub from 2-5 ft. high, but may attain a height of 18 ft. with a diameter of 4 inches. Usually occurs in clumps but may occur solitary.

BARK—Thin, bitter, light brown, marked with light gray blotches, at first smooth, but later when trunk reaches a diameter of 4 inches it becomes rough.

TWIGS—Smooth, slender, at first dark green and rusty-pubescent but later reddish-brown and smooth, marked with rather inconspicuous pale lenticels.

BUDS—Alternate, ovate, rounded at apex, light brown, covered with thin overlapping scales which are sometimes hairy on margin.

LEAVES—Alternate, simple, obovate, 3-6 inches long, 2-3 inches wide, covered beneath with pale tomentum, short and stout-petioled, margined with 3-7 rounded teeth on each margin and terminated with acute or acuminate apex.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate aments 1½-2½ inches long, yellow and somewhat hairy. Pistillate flowers short-stalked and bear bright red pistils.

FRUIT—An acorn, maturing at end of first season; ½-⅞ of an inch long, sessile or short-stalked, often produced in great abundance, singly or in pairs. **Nut** oval, light chestnut-brown; when young striated with dark longitudinal lines; blunt-pointed, shiny except at apex where it is often covered with pale down. Kernel sweet and edible. **Cup** thin, rather deep, covers about ½ of nut, pale woolly outside, downy inside. Scales are indistinct, thinner towards apex, often knobby or tumid towards base.

WOOD—Ring-porous; with consipcuous medullary rays. Commercially not important on account of small size. Locally used for fuel.

DISTINGUISHING CHARACTERISTICS—The Scrub Chestnut Oak, also known as Dwarf Chinquapin Oak, Chinquapin Oak and Scrub Oak, can readily be distinguished from most of the Oaks of Pennsylvania by its dwarf forms. It resembles the Bear Scrub Oak rather closely but can be distinguished from it by its round-lobed leaves, knobby acorn-scales, scaly and often gray-blotched bark on larger stems, and sweet kernel of the acorns. The young branches of this species are pubescent while those of the Scrub Oak are usually smooth. The buds are small and not so sharp-pointed as those of the Chestnut Oak and the Yellow Oak.

RANGE—Maine to North Carolina, west to Kansas and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally in the eastern, southern and central parts of the State, nowhere very common.

HABITAT—Prefers dry woods, rocky slopes or sandy soils. Occasionally found in hillside pastures and moist woods.

IMPORTANCE OF THE SPECIES—The Scrub Chestnut Oak is so small in size that it ha practically no commercial value. It is hardly more than a forest weed and should not be planted or protected except where it might be used as an advance growth.

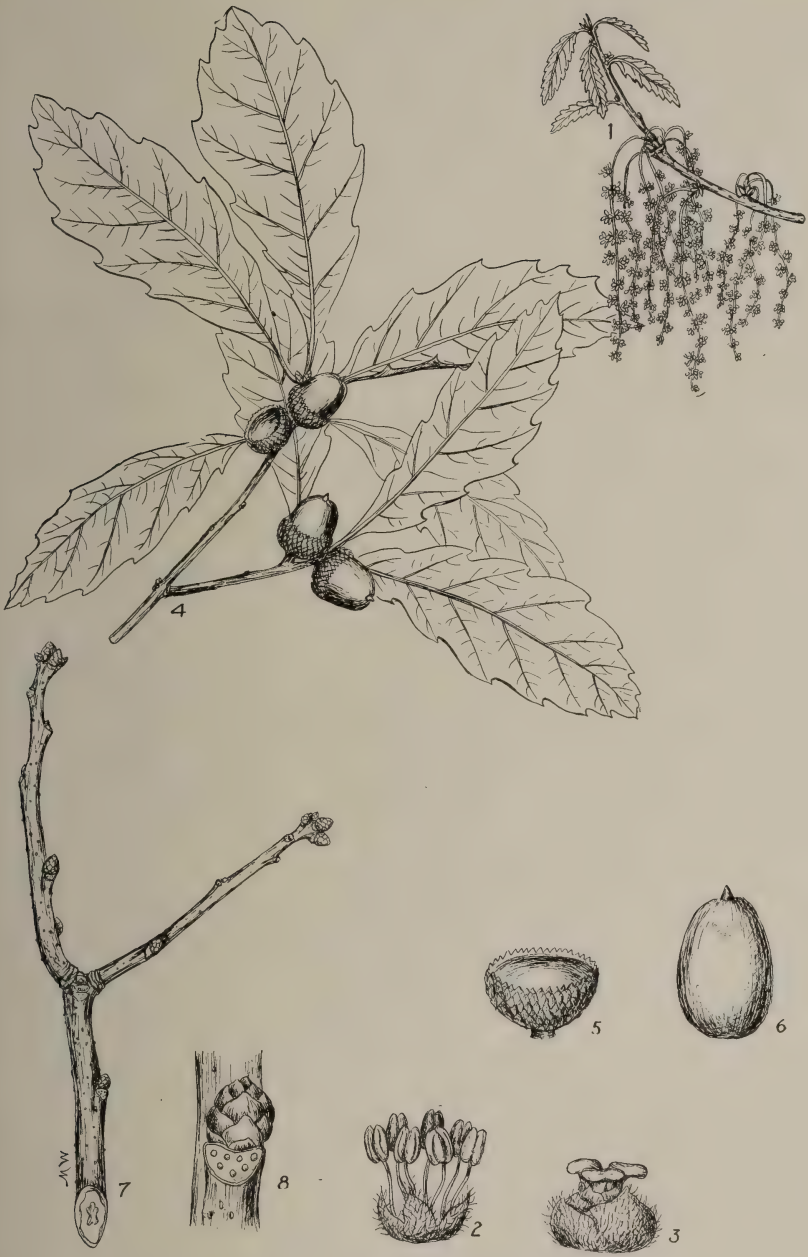

PLATE LXI. SCRUB CHESTNUT OAK.

1. Flowering branch with immature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A fruiting branch, x ½.
5. An acorn cup, x ½.
6. An acorn, x ½.
7. A winter twig, x ½.
8. Section of a winter twig, enlarged.

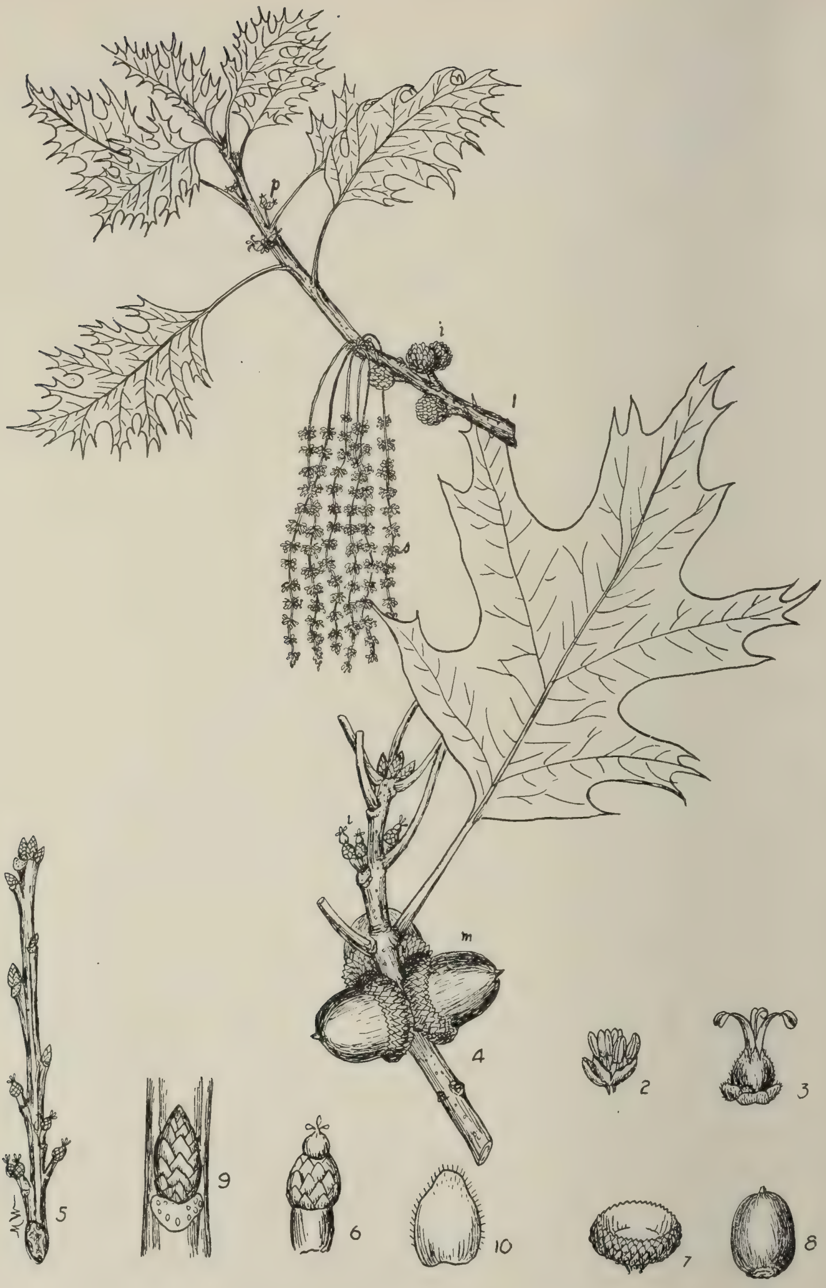

PLATE LXII. RED OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. Branch with mature leaves, (i) immature acorns, (m) mature acorns, x ⅓.
5. Winter twig with immature acorns, buds, and leaf-scars, x ½.
6. An immature acorn, enlarged.
7. An acorn cup, x ½.
8. An acorn, x ½.
9. Section of a twig, enlarged.
10. A bud-scale, enlarged.

RED OAK.

Quercus rubra, Linnaeus.

FORM—One of the largest forest trees of the Northern States, usually attaining a height of 70-90 ft. with a diameter of 2-4 ft. but occasionally reaching a height of 150 ft. with a diameter of 5 feet. When grown in the open has a short trunk and a broad symmetrical crown; in dense forest stands the trunk is straight, clean and continuous bearing a small, narrow crown. The straight ascending and clean branches of the crown are characteristic.

BARK—On young stems and branches smooth, gray to brown; on older trunks it is thick, slowly broken up by shallow fissures into regular, continuous, dark-brown and distinctly flat-topped ridges. Trunks above 3 ft. in diameter are often very rough near the base, having lost the characteristic flat-topped ridges which are, however, retained higher up on the stem. See Fig. 72.

TWIGS—Rather slender, smooth, greenish-brown to dark brown, covered with pale indistinct lenticels; pith star-shaped.

BUDS—Alternate, ovoid, 1/6-1/3 of an inch long, widest part near middle, narrowed upward to a sharp point, light brown, and free from woolly covering. Bud-scales numerous, overlapping, light brown, slightly longitudinally-striate, with slightly pubescent margins.

LEAVES—Alternate, simple oval to obovate in outline, 5-9 inches long, 4-6 inches wide, 7-9-lobed, with sinuses extending half-way to the midrib and separating ascending lobes with entire margin or few bristle-pointed teeth. Mature leaves firm, dull green, with yellowish to reddish midrib above and pale with a yellowish midrib below.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are about ½ developed. Staminate borne in slender, hairy aments 4-5 inches long, with greenish 4-5-lobed calyx and 4-5 stamens terminated by yellow anthers. Pistillate borne on short stalks; involucral scales broadly ovate, blunt, pubescent; calyx lobes sharp-pointed; style spreading recurved, light green.

FRUIT—An acorn, maturing at the end of second season, solitary or paired, short-stalked. Nut ovoid, ¾-1¼ inches long, flat at base, narrowed at apex. Cup velvety inside, broad, shallow, covering only base of nut, with closely imbricated, sometimes hairy, reddish-brown scales. Immature acorns usually divergent from twig, with basal scales reaching about ⅔ of the way up,and appearing as if arranged in 3 rows.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, strong, hard, close-grained, light reddish-brown, with thin lighter colored sapwood. Used for furniture, cooperage, construction, interior finish of houses, and railroad ties. Weighs 41.25 lbs. per cubic foot. The wood of this species as well as that of the Black Oak and Scarlet Oak is relatively poor but is coming more into use daily. The despised species of to-day may be prized to-morrow.

DISTINGUISHING CHARACTERISTICS—The Red Oak may be recognized by its flat-topped ridges of the bark, its straight clean branches, its large dull green leaves with red midribs and ascending lobes with entire or few bristle-teeth, its light reddish inner bark, its glabrous, sharp-pointed, light brown buds which are often constricted at the base, and its large acorns with broad and shallow cups.

RANGE—Nova Scotia to Minnesota and Kansas, south to Florida and Texas. Planted extensively in Europe for ornamental and forestry purposes.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. At its optimum in the Cumberland Valley and adjoining lower slopes. Rarer in the northern than in other parts.

HABITAT—Prefers porous sandy or gravelly clay soil. It will not grow in wet soils and is also intolerant of shade, except when young.

IMPORTANCE OF THE SPECIES—The Red Oak is the most rapid growing species of all the Oaks. In one year it has grown to the height of 19 inches, in 10 years 18 feet, 20 years 33-39 feet, 50 years 50-57 feet. It deserves to be planted and regenerated naturally on an extensive scale. In a single small nursery the Pennsylvania Department of Forestry in 1911 raised over 200,000 seedlings of this species. In Germany it has at present a wider distribution than any other American hardwood species. It is very attractive ornamentally on account of its smooth bark, straight branches, and the form and autumnal coloration of its leaves.

PIN OAK.

Quercus palustris, Muench.

FORM—A medium-sized tree usually attaining a height of 50-60 ft. with a diameter of 2 ft., but may reach a maximum height of 120 ft. with a diameter of 3 feet. Trunk straight, usually clean, continuous, and bears a symmetrical conic crown. The lower lateral branches are short and drooping, the middle horizontal, and the upper ascending. The form of the tree is characteristic. See Figs 38 and 39.

BARK—On old trunks relatively smooth but slightly roughened by shallow fissures separating low ridges which are covered by small close scales. On young trunks shining, very smooth, light brown to reddish. See Fig. 76.

TWIGS—Slender, tough, lustrous, at first hairy, later smooth, dark red to grayish-brown, covered with pale and inconspicuous lenticels.

BUDS—Alternate, smooth, ⅛ of an inch long, small, ovoid, sharp-pointed, covered with light brown scales which may sometimes be slightly hairy on the margin.

LEAVES—Alternate, simple, 4-6 inches long, 2-4 inches wide, ovate in outline, 5-9-lobed; lobes bristle-pointed, separated by broad deep and round-based sinuses. When full grown dark shining green above, pale green and smooth below, often with small tufts of hairs in the leaf axis.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are about ⅓ developed. Staminate flower in slender and hairy aments from 2-3 inches long. Pistillate short-stalked and terminate by spreading bright red styles.

FRUIT—An acorn, maturing at the end of the second season, solitary or in pairs. Nu globose, light brown, often striped, about ½ of an inch long. Cup thin, saucer-shaped, shallow ½ of an inch across, encloses only about 2/5 of nut, covered with thin closely overlappin scales. Kernel bitter and pale yellow.

WOOD—Ring-porous; with conspicuous medullary rays; heavy, strong, hard, close-grained checks and warps badly during seasoning. Weighs 43.24 lbs. per cubic foot. Used fo cheap construction, cheap cooperage, railroad ties, and occasionally for interior finish.

DISTINGUISHING CHARACTERISTICS—The Pin Oak, also known as the Swamp Oak an Water Oak, when young and especially when open grown, can readily be recognized by it characteristic form. Its trunk is continuous, relatively smooth, and covered by many slende and rather short lateral branches which are drooping below, erect above, and horizont in the middle. It frequents moist locations and bears small acorns with shallow cups. Th branchlets are often beset with short, stiff lateral shoots which give it its common nam The buds are small, smooth, sharp-pointed, and light brown in color.

RANGE—From Massachusetts to Michigan and Missouri, south to Virginia, Tennessee, ar Oklahoma.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts. Occ sional in the mountainous parts. Sparse in the western part.

HABITAT—It occurs in rich moist soil of river bottomlands, along streams, on border swamps, and even thrives in fertile soil on the slopes and summits of the Allegheny mountai

IMPORTANCE OF THE SPECIES—This species does not rank high from a commerci point of view even among the Black Oak group of which it is a member. It is singular beautiful for ornamental purposes. It deserves to be planted extensively as a shade, par or avenue tree on account of its rapid growth, its beautiful form, and autumnal foliage, and t ease with which it is transplanted. Its commercial value, however, does not recommend it f extensive planting for forestry purposes.

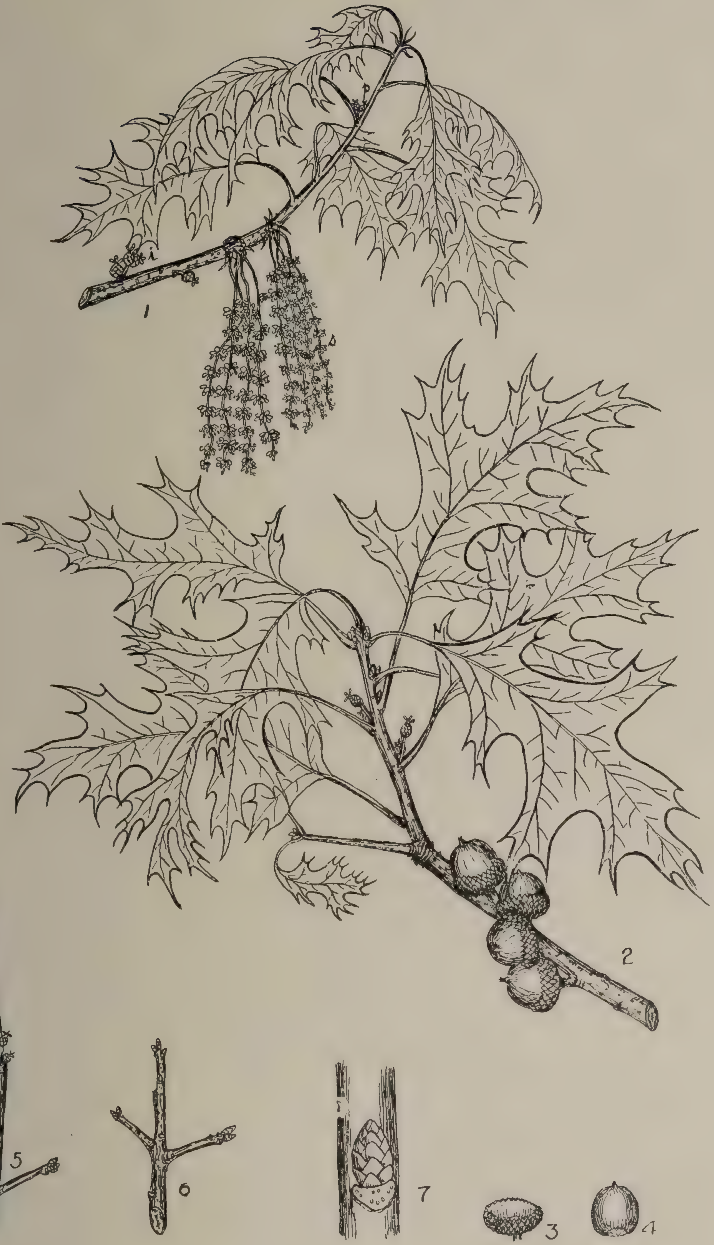

PLATE LXIII. PIN OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with immature acorns, buds, and one pin-like branchlet, x ½.
6. Winter branch with two pin-like branchlets, x ½.
7. Section of a winter branch, enlarged.

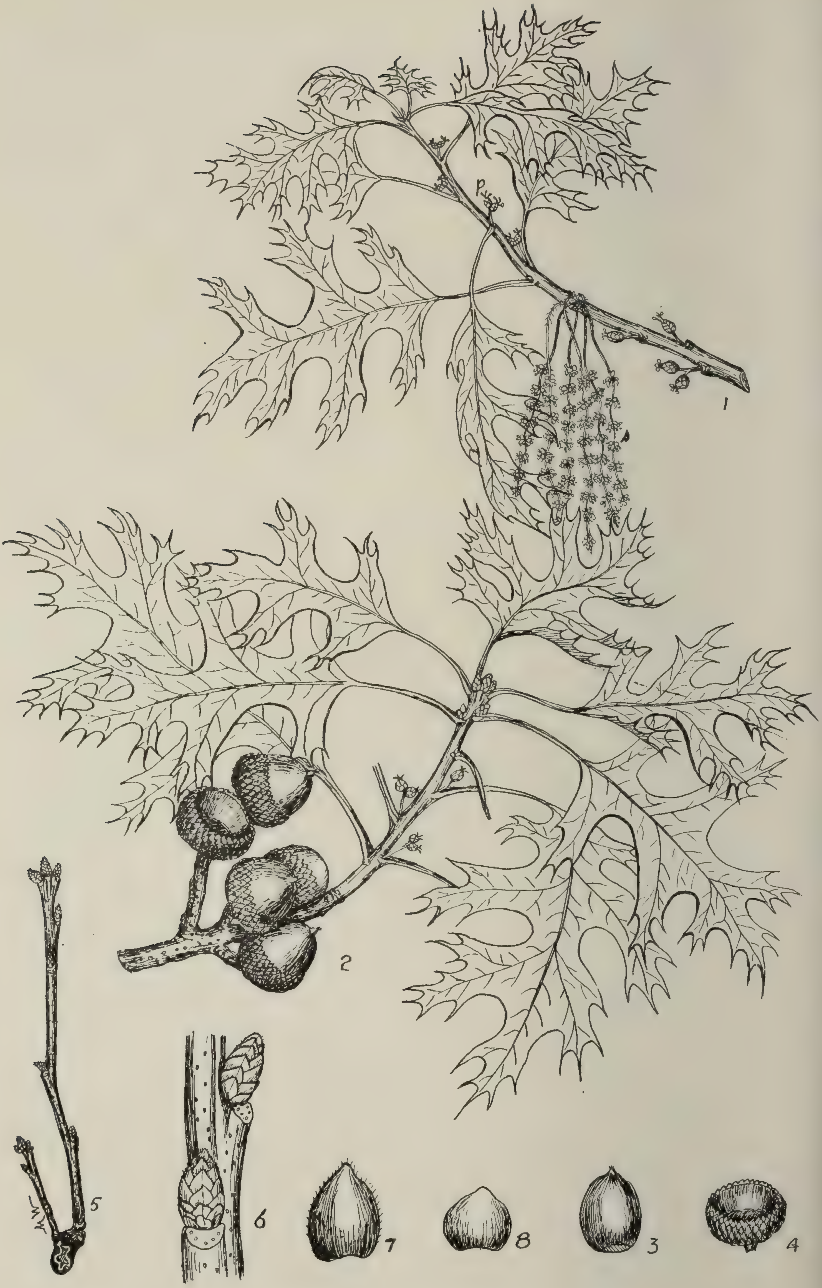

PLATE LXIV. SCARLET OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn, x ½.
4. An acorn cup, x ½.
5. Terminal section of a winter twig, x ½.
6. Section of a winter twig showing lenticels, leaf-scars with bundle-scars, and two slightly angular buds covered with numerous over-lapping scales, enlarged.
7. An apical bud-scale with ciliate margin, enlarged.
8. A basal bud-scale, enlarged.

SCARLET OAK.

Quercus coccinea, Muench.

FORM—An average-sized tree usually attaining a height of 60-80 ft., but occasionally reaching a height of 150 ft. with a diameter of 4 feet. Lateral branches ascending above, horizontal in middle, drooping below. Lateral branches are slender and lower ones die readily from shading, only persist for many years. Trunk very tapering, crown shallow and narrow.

BARK—On old trunks intermediate between the Red Oak and the Black Oak. It is broken up into rough, irregular, deep fissures which separate ridges not so rough as those of the Black Oak and not so flat-topped as those of the Red Oak. Inner bark red to gray. On younger limbs thin, smooth, light brown. See Fig. 78.

TWIGS—Slender, smooth, reddish or grayish-brown, covered with numerous, small, pale lenticels; pith star-shaped.

BUDS—Alternate, broadly ovate, narrowed to a blunt apex, ⅛-¼ of an inch long, dark reddish-brown, covered with a pale wool from the middle to the apex.

LEAVES—Alternate, simple, broadly oval to obovate, 3-6 inches long, 2½-5 inches wide, 5-9-lobed, lobes bristle-pointed and separated by deep round-based sinuses extending at least ⅔ of the distance to the midrib. In autumn brilliantly scarlet before falling.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers are borne in slender pubescent aments 3-4 inches long. Pistillate on short pubescent stalks, reddish in color, with reflexed bright red stigmas.

FRUIT—An acorn, maturing at the end of the second season, sessile or short-stalked, solitary or paired. Nut ovoid, 2/5-4/5 of an inch long, reddish-brown, occasionally striate. Cup thin, covering about ½ of the nut, narrowed at base, with closely imbricated, sharp-pointed, slightly downy scales often forming a fringe at the cup margin which is closely appressed to the nut.

WOOD—Ring-porous; with prominent medullary rays; strong, heavy, coarse in texture. Weighs 46.15 lbs. per cubic foot. The wood has little commercial value as timber.

DISTINGUISHING CHARACTERISTICS—The Scarlet Oak is one of the commonest of the Black Oak group and can readily be distinguished from the Black Oak by its smoother bark ridges on the trunk, its paler inner bark, its deeper round-based leaf-sinuses, its smooth, close-fitting scales of the acorn-cup, and its stouter, often smaller, less angular buds which are covered with pale wool only from the middle to the apex while the Black Oak is distinctly woolly over the entire bud. It can be distinguished from the Red Oak by its smaller and more deeply lobed leaves, its less flat-topped ridges of the bark, its smaller and deeper-cupped acorns, and its buds which are covered with a pale wool from the middle to the apex while those of the Red Oak are free from wool. The persistent, stunted, often drooping and dead lateral branches are also peculiar to this tree. This characteristic is common to trees on the border of bodies of water.

RANGE—Maine to Minnesota, south to North Carolina and Nebraska.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern, central, and southern parts. Sparse in western part. Rare in northern part.

HABITAT—Prefers dry sandy soil. Frequently met upon light stony or sandy uplands but the best individuals occur on good soil at the base of the slopes where it is often found bordering hollows filled with water during spring.

IMPORTANCE OF THE SPECIES—The wood of the Scarlet Oak is of little commercial importance as compared with some of the other oaks. The wood is sold on the market as Red Oak but is inferior in quality to the latter. This species is often attacked by fungi when it has reached medium size, which causes the wood to rot and often results in wind-break in the forest. This species on account of its fast growth, beautiful foliage with its special autumnal coloration, is one of the most desirable trees for street or park.

BLACK OAK.

Quercus velutina, Lambert.

FORM—One of the largest Oaks of Pennsylvania usually 60-80 ft. high, but may attain a maximum height of 150 ft. with a diameter of 4½ feet. Trunk usually clean and continuous giving off ascending branches above and horizontal ones below. Branches rather stout and zigzag. Crown deep, irregular, narrow to wide-spreading, oblong in outline.

BARK—On young stems smooth and dark brown, but soon becoming rough and black. On old trunks very rough, thick, broken into deep fissures separating thick ridges which are cross-fissured. Young trees 2-4 inches in diameter often start to develop rough bark. Inner bark is yellow and bitter, a good distinguishing characteristic. See Fig. 74.

TWIGS—Stout, rusty-pubescent, reddish-brown, angular, longitudinally ridged from leaf-scars; taste bitter; covered by rather conspicuous pale lenticels.

BUDS—Alternate, ovate, large, ⅓-½ of an inch long, strongly angled, tapering to obtuse apex, covered with numerous overlapping bud-scales with a coating of yellowish to dirty-white pubescence.

LEAVES—Alternate, simple, obovate to oblong, 4-6 inches long, 3-4 inches wide, usually 7-lobed terminated by bristle points. Mature leaves are dark green and smooth above and pale to yellowish-green below with tufts of rusty hairs in axil of veins at midrib. The leaves vary from those of the Red Oak. No other Oak produces so many differently shaped leaves on the same tree.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers occur in hairy aments 4-6 inches long. Pistillate are borne on short hairy stalks.

FRUIT—An acorn, maturing during two seasons, sessile or stalked, solitary or clustered. Nut ovate to oval, ½-1 inch long, light reddish-brown, often coated with pubescence and longitudinally striate. Cup thin, tapering at base, dark reddish-brown, embracing ½ nut, covered with thin, light brown, sharp-pointed, hairy scales tightly overlapping at base and loosely overlapping at margin so as to form a fringe-like margin to the cup.

WOOD—Ring-porous; with conspicuous medullary rays; hard, heavy, strong, not tough, durable, checks readily. Heartwood is light brown, with lighter-colored sapwood. Weighs 43.90 lbs. per cubic foot. Used for furniture, interior finish, cheap cooperage, and ordinary construction. In general it finds the same uses as Red Oak.

DISTINGUISHING CHARACTERISTICS—The Black Oak is also known as Yellow Oak and Quercitron on account of its yellow inner bark. The dark colored and rough outer bark, even on young stems, and the yellow inner bark are at all seasons of the year definite marks of identification. The leaves, which vary from the shallow lobed ones similar to those of the Red Oak to the deep lobed ones similar to those of the Scarlet Oak, may also help to identify the species. No other species of Oak has so many varieties of leaves on the same tree as the Black Oak. In autumn the small acorns with the cup embracing one-half of the nut may also help to distinguish it from some species like the Red Oak and the Pin Oak. The large, angular buds covered over the whole surface with a pale wool are sure characteristics.

RANGE—Maine to Western Ontario, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern, central, and southern parts. Sparse in western part. Rare in the northern part.

HABITAT—Usually found on dry uplands, gravelly plains and ridges, especially in the Appalachian foothills. Seldom found in rich bottomlands. In the west usually found on sterile, sandy, or glaciated hills.

IMPORTANCE OF THE SPECIES—The Black Oak should be propagated only where no better trees can be grown. If its reproduction is thought desirable it should be attempted by natural seed regeneration or planting of seeds since planting of young seedlings from the nursery is expensive and success doubtful. Formerly the yellow inner bark was in demand because an extract in the form of a yellow dye, known as "Quercitron," was obtained from it. The introduction of aniline dyes has decreased the demand. The Black Oak is not attractive as an ornamental tree.

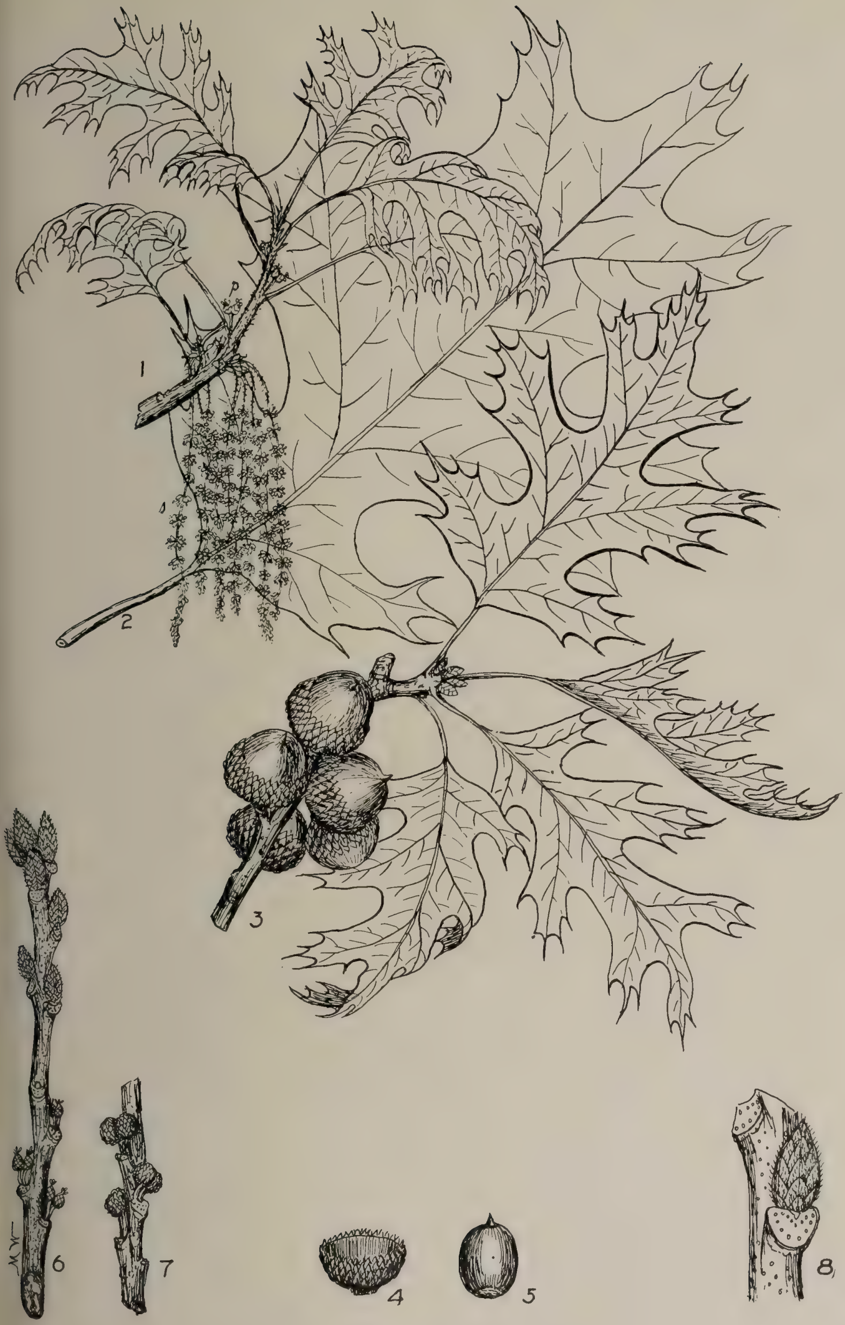

PLATE LXV. BLACK OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. A mature leaf, x ½.
3. Branch with leaves and mature fruit, x ½.
4. An acorn cup, x ½.
5. An acorn, x ½.
6. Winter twig with buds, leaf-scars, and immature acorns, x ½.
7. Section of twig with immature acorns, x ½.
8. Section of winter twig showing the large, angular and pubescent bud and leaf-scars with bundle-scars, enlarged.

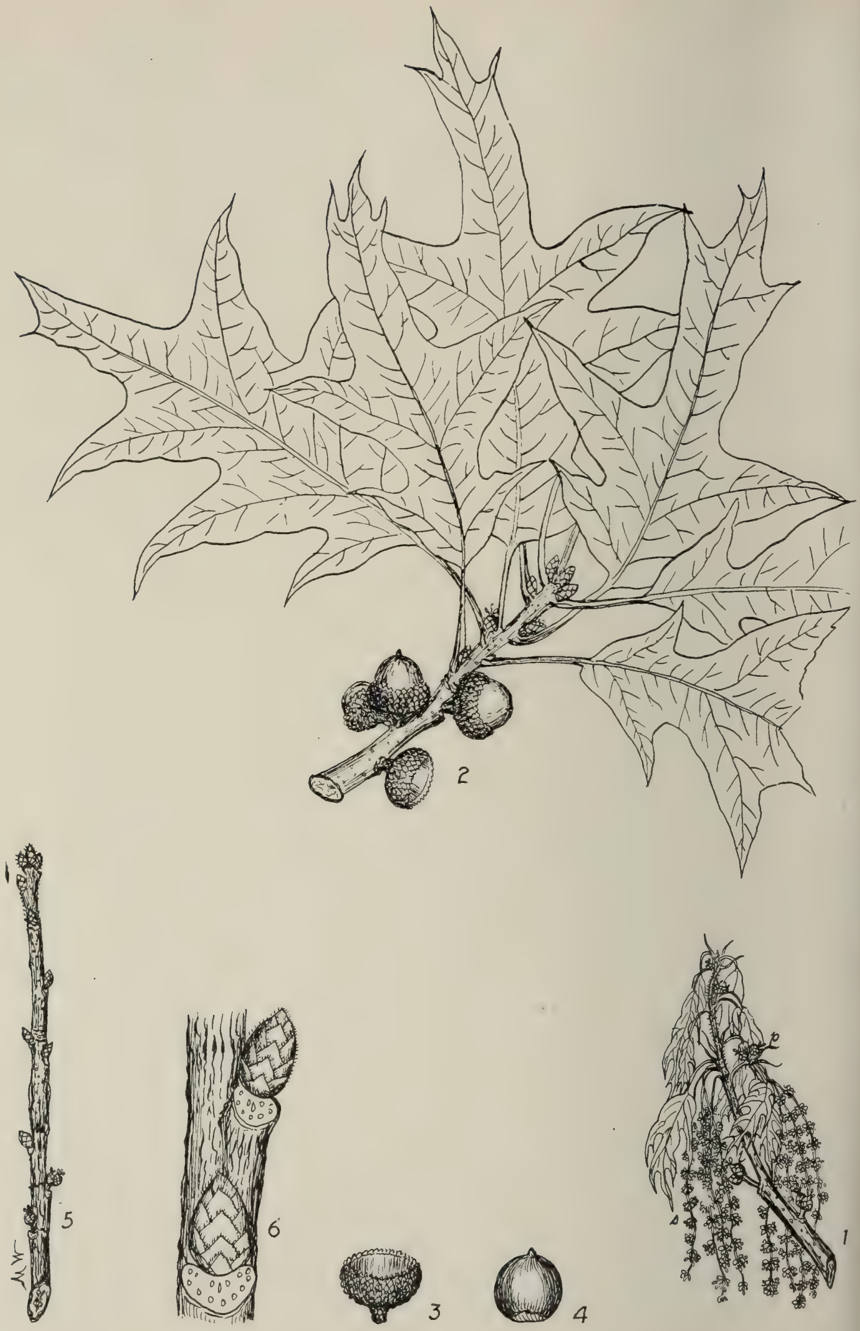

PLATE LXVI. SPANISH OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with immature acorns, buds, and leaf-scars, x ½.
6. Section of a winter twig showing buds, leaf-scars, and bundle-scars, enlarged.

SPANISH OAK.

Quercus falcata, Michaux.

FORM—A medium-sized tree usually attaining a height of 70-80 ft. with a diameter of -3 ft. but which may reach a maximum height of 120 ft. with a diameter of 4½ feet. Crown pen, broad, round-topped, rather deep.

BARK—On old trunks divided by shallow fissures which separate low, brown, scaly ridges. n young parts thin, smooth, dark reddish-brown to gray and rich in tannic acid.

TWIGS—Stout, at first covered with rusty hairs, later almost smooth and reddish-brown o ashy-gray.

BUDS—Alternate, ovoid, sharp-pointed, ⅛ of an inch long, bright chestnut-brown, hairy.

LEAVES—Alternate, simple, 6-7 inches long, 4-5 inches broad, ovate in outline, 3-7 lobed; obes bristle-pointed and separated by broad variable sinuses. They are dark green and shining bove, covered with grayish down beneath. The leaves are very variable in outline.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Flowers appear in April or May when the leaves are about ⅓ developed. Stamiate flowers are borne in slender hairy aments about 3-5 inches long. Pistillate on stout hairy talks and terminated by rather short, divergent, dark red styles.

FRUIT—An acorn, maturing at the end of the second season; short-stalked. Nut ovoid to gloose, rounded at apex, about ½ of an inch long, pale orange-brown, enclosed only at base for length. Cup hemispheric, ½-⅔ of an inch across, covered by thin reddish scales which are ale pubescent especially on the margins.

WOOD—Ring-porous; with conspicuous medullary rays; hard, strong, not durable, with ight red heartwood, lighter sapwood. It warps and checks badly. Weighs 43.17 lbs. per cubic oot. Largely used for fuel and also used in construction. Bark is rich in tannin.

DISTINGUISHING CHARACTERISTICS—The Spanish Oak bears leaves which resemble those f the Scrub Oak, only that the lobes of the latter are usually short and triangular while those f the former are mostly long and lanceolate. The Scrub Oak attains the height of a small tree nly, while the Spanish Oak may reach a height of 100 feet. It can be distinguished from he other closely related members of the Black Oak group in this State by its white or rayish-tomentose coating on the lower leaf surface.

RANGE—New Jersey and southeastern Pennsylvania to Missouri, south to Florida and exas.

DISTRIBUTION IN PENNSYLVANIA—Reported only from the southeastern and southern arts of the State.

HABITAT—It is usually found on dry gravelly or sandy soil. In the South it is common etween the coastal plain and the Appalachian mountains.

IMPORTANCE OF THE SPECIES—Since the natural distribution in this State is limited o a few local places in the southeastern and southern parts and on account of its inferior ood, it cannot be recommended for forestry purposes. Other more valuable species should e propogated in its stead. It is rather attractive as an ornamental tree and its bark lso is rich in tannin.

SCRUB OAK.

Quercus ilicifolia, Wangenheim.

FORM—Shrub or small tree with many crooked intertwined branches; usually 4-8 f high with a diameter of 1-3 inches, but occasionally attaining a height of 18-20 feet. Se Fig. 4.

BARK—Thin, smooth, becoming scaly on older stems, gray to dark brown in color.

TWIGS—When young slender, dark green, tinged with red, and tomentose; becoming gr to reddish-brown, finally dark brown and smooth.

BUDS—Alternate, ovate, obtuse, ⅛ of an inch long, chestnut-brown; covered by numero small dark-margined closely appressed scales.

LEAVES—Alternate, simple, 2-5 inches long, 1½-3 inches wide, obovate in outline, wi a wedge-shaped base, 3-7-lobed, usually 5; with shallow sinuses and acute and bristle-tipp lobes. Mature leaves dark green and glossy above, covered with a dense whitish pubescen beneath, thick and leathery in texture, with conspicuous yellow midribs and veins. Petiol round, tomentose and about 1 inch long.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate aments 4-5 inch long, often clinging to twigs until late summer. Pistillate flowers borne upon stout tome tose stalks, have an involucre of red scales, and red stigmas.

FRUIT—An acorn, maturing at end of second season, very abundant, sessile or nearly s usually clustered, seldom solitary. Nut broadly ovoid, with a flat rounded base, acute rounded apex, about half enclosed in the cup, light brown, shiny and often slightly striat ½ of an inch broad and long. Cup pale and reddish-brown and soft downy within, cover on the outside with many closely set reddish-brown scales whose free tips form a frin around the edge of the cup. Kernel bright yellow.

WOOD—Ring-porous; with conspicuous medullary rays; pale brown, strong, hard, toug and fine-grained. Commercially not important on account of its small size. Locally us for fuel.

DISTINGUISHING CHARACTERISTICS—The Scrub Oak, also known as Bear Oak a Ground Oak, can easily be distinguished by characteristic bristle-pointed leaves shown i the opposite plate, which turn reddish-brown or brown in autumn, and often persist through the winter. It is small in size and forms dense thickets over large areas, especially recen burned areas. The smooth non-scaly bark, persistent clusters of fruit and the small, brov bluntly conical buds covered with slight pubescence are characteristic. In habit it resemb the Scrub Chestnut Oak, but the latter has a flaky bark and round-lobed leaves a characteristic fruit.

RANGE—Maine to Ohio south to North Carolina and Kentucky.

DISTRIBUTION IN PENNSYLVANIA—Common in most of the counties in and east of Allegheny Mountains. Found in some of the counties in the southwestern portion of the Sta Sparse in the north-central and northern parts.

HABITAT—Usually found on rocky hillsides, sandy plateaus, and mountain tops. It s gregarious and able to flourish upon barren, dry, infertile soils, but cannot endure much shad hence it seldom occurs in mixture with other species. It has overgrown extensive areas f burnt-over land in this State.

IMPORTANCE OF THE SPECIES—The Scrub Oak is of no commercial value but is economica important on account of its ability to grow upon the most exposed and inhospitable situati This makes it worthy of consideration in protection forests, where it shelters the forest-flo prevents erosion and enriches the soil with accumulations of humus. In time it is usually d placed by species of greater commercial importance as Chestnut, Scarlet Oak, Chestnut O Maple, and Aspen. Areas once covered with thickets of this species now often have o a few single representatives left.

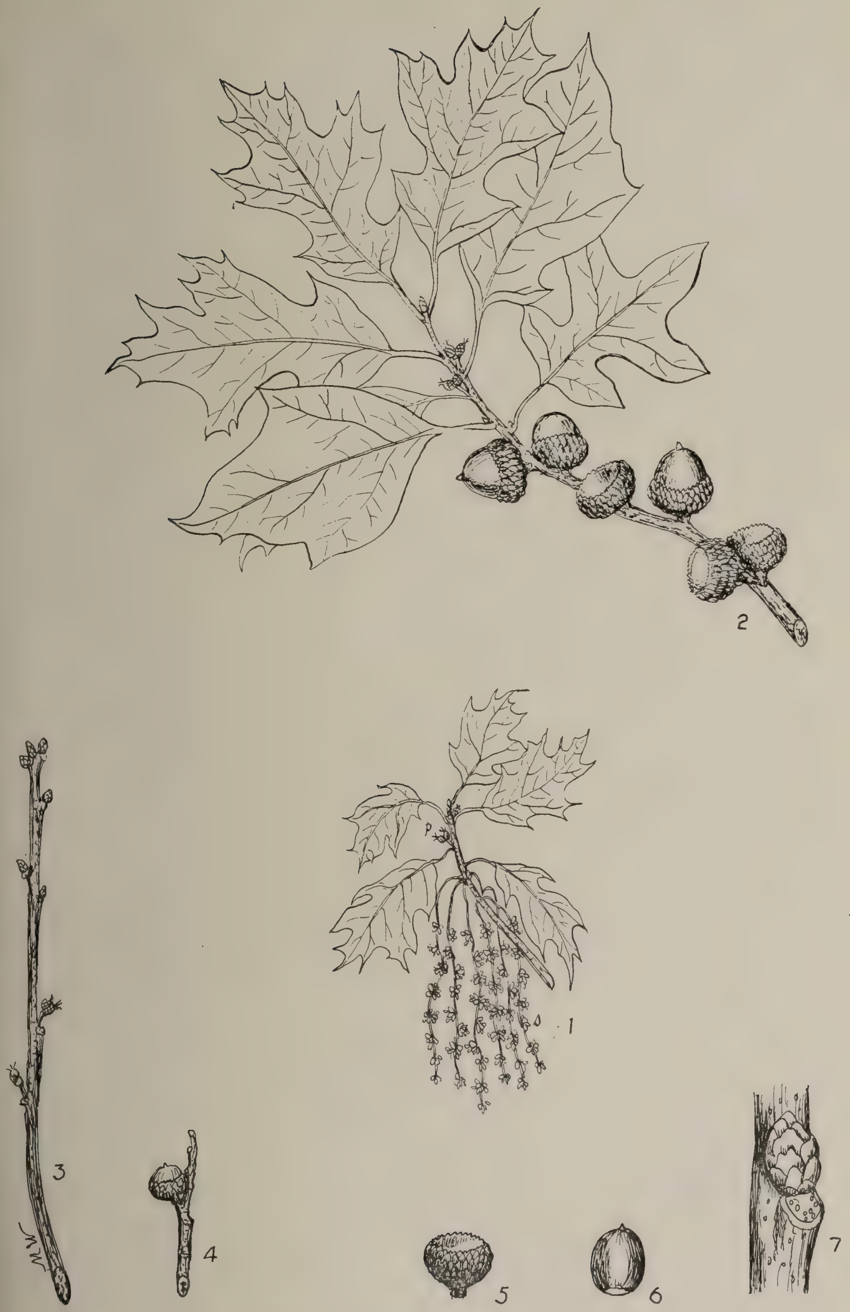

PLATE LXVII. SCRUB OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. Terminal section of a winter twig, x ½.
4. Winter twig with an acorn, x ½.
5. An acorn cup, x ½.
6. An acorn, x ½.
7. Section of a winter twig showing a leaf-scar with bundle-scars, lenticels, and a bud with numerous over-lapping scales, enlarged.

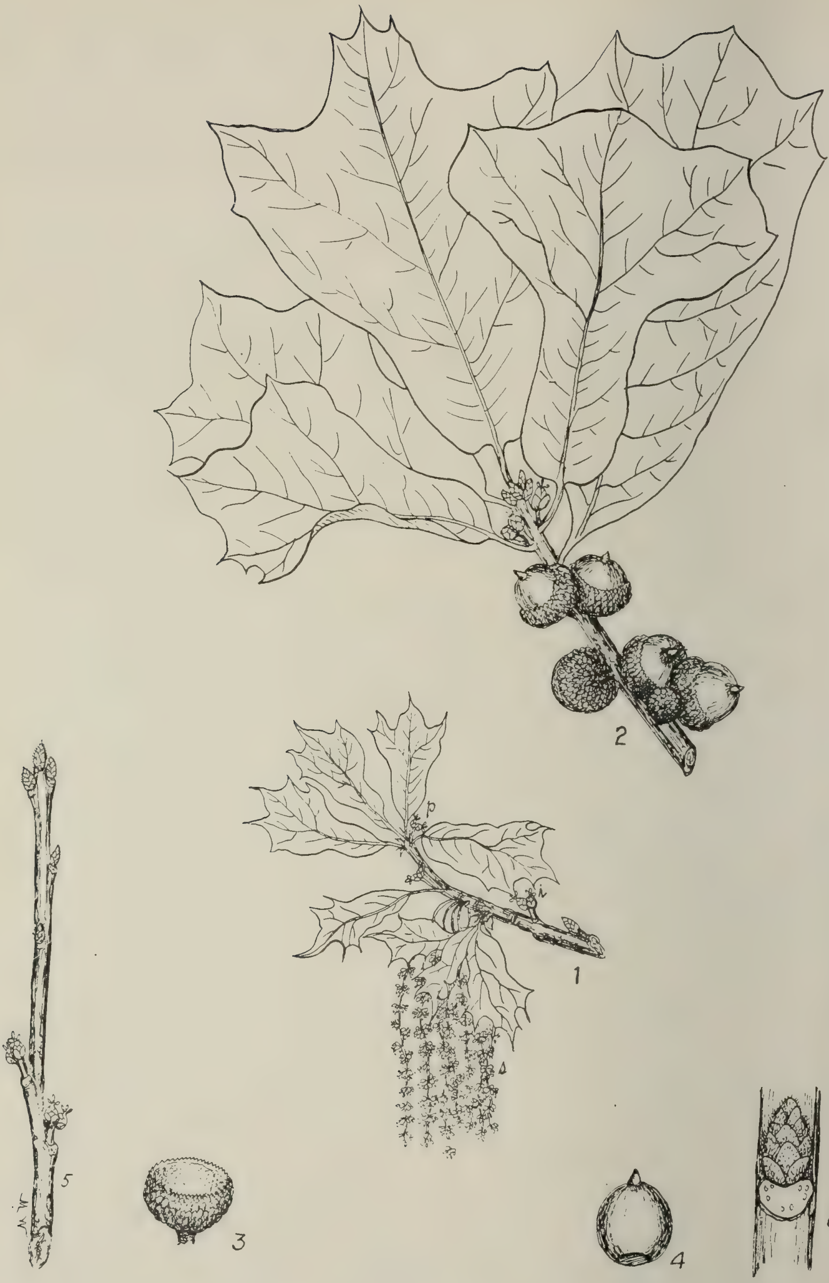

PLATE LXVIII. BLACK JACK OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with immature acorns, buds, and leaf-scars, x ½.
6. Section of a winter twig, enlarged.

BLACK JACK OAK.

Quercus marilandica, Muench.

FORM—This tree usually attains a height of 20-30 ft. with a diameter of 18 inches, but may reach a height of 60 ft. with a diameter of 3 feet. It reaches its maximum size in Texas and Arkansas. Crown usually compact, round-topped, and narrow on account of short branches. Upper branches are ascending, lower ones spreading.

BARK—Thick, roughened by deep fissures which separate broad angular plates covered with dark brown to nearly black scales.

TWIGS—Stout, coated at first with pale woolly covering of hairs, later becoming smooth and dark brown to gray.

BUDS—Alternate, ovate, distinctly angular, sharp-pointed, ¼ of an inch long, reddish-brown and rusty pubescent.

LEAVES—Alternate, simple, broadly ovate in outline, 6-7 inches long with an almost equal width, rounded or heart-shaped at the base, 3-5-lobed. Mature leaves deep green, thick, leathery, and smooth above; often rusty brown below.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when the leaves are ⅓ developed. Staminate flowers in slender, often persistent aments 2-4 inches long. Pistillate flowers on short, stout, pubescent stalks.

FRUIT—An acorn, maturing at the end of the second season, solitary or paired, short stalked. Nut ovoid ¾ of an inch long, nearly same width throughout, often striate, light brown. Cup hemispheric, deep, covers one-half or over of nut, light brown and downy on inside, covered by large reddish-brown loosely overlapping scales. Small scales form a thin rim around the margin.

WOOD—Ring-porous; with conspicuous medullary rays; dark brown, heavy, hard, strong. Weighs 45.64 lbs. per cubic foot. Used for fuel, charcoal, and manufactured into lumber to a limited extent.

DISTINGUISHING CHARACTERISTICS—The Black Jack Oak, also known as Jack Oak and Barren Oak, can be distinguished by the large obovate leaves which are usually 3-5-lobed above the middle, or sometimes entire and covered with rusty brown pubescence. It is the only Oak of Pennsylvania which has its leaves dilated near apex. Its sharp-pointed, distinctly angular and somewhat hairy bud and its hemispheric acorn cup also aid in distinguishing it from the other closely related species.

RANGE—New York and Pennsylvania west to Nebraska and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Occasional in the eastern and southern parts of the State and a few local outposts in the western part.

HABITAT—Usually found on poor, dry, sterile, sandy soil, but in the South it is also found on clay. It reaches its best development upon the rich soil in the southern part of its distribution.

IMPORTANCE OF THE SPECIES—In the North it is a shrub only or a small tree of no commercial importance, while in the South it becomes somewhat larger and is used for fuel, charcoal, and lumber. In Pennsylvania it is of no forestal importance, but is a very attractive tree for ornamental purposes on account of its compact and deep crown.

LAUREL OAK.

Quercus imbricaria, Michaux.

FORM—A tree usually attaining a height of 50-60 ft. but may reach a height of 100 ft. with a diameter of 3 feet. Crown in mature trees rather open, often shallow, while in younger specimens it is pyramidal, rather closed, and the lateral drooping branches often touch the ground.

BARK—Up to 1½ inches in thickness, roughened by shallow fissures which separate ridges covered by close light brown scales. On younger stems thin, often smooth and shiny.

TWIGS—Slender, at first dark green and lustrous; later light brown to dark brown.

BUDS—Alternate, ovate, sharp-pointed, slightly angular, ⅛ of an inch long and covered with numerous close-fitting, overlapping, erose, chestnut-brown scales with serrate margins.

LEAVES—Alternate, oblong to lanceolate, 4-6 inches long, 1-2 inches wide, wedge-shaped or round at the base, acute at apex, with usually entire or undulate margins. Mature leaves are thin, dark and shiny above; pale green and hairy below.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers in hairy aments 2-3 inches long. Pistillate on short stalks above staminate.

FRUIT—An acorn, maturing at the end of the second season, solitary or in pairs, stalked. Nut ovoid ½-⅓ of an inch long, dark brown. Cup embraces almost ½ of nut, saucer-shaped, brown and shining inside, covered by numerous, closely overlapping, reddish-brown, hairy scales.

WOOD—Ring-porous; with conspicuous medullary rays; hard, coarse-grained, reddish-brown. It checks easily and consequently finds a limited use in construction work. Weighs 46.92 lbs. per cubic foot. Used for fuel, charcoal, shingles, and manufactured into lumber.

DISTINGUISHING CHARACTERISTICS—The Laurel Oak, also known as Shingle Oak, Jack Oak, and Water Oak, may readily be distinguished from all the other Oaks of Pennsylvania except the Willow Oak, by its characteristic leaf. The Willow Oak is smaller, has narrower and sharper-pointed leaves which are not hairy beneath. The leaves of this species are hairy beneath. The acorns are larger and the cups not so flat as those of the Willow Oak. The winter buds of the Laurel Oak are light chestnut-brown and somewhat angular, while those of the Willow Oak are dark chestnut-brown.

RANGE—Pennsylvania to Michigan and Nebraska, south to Georgia and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Found locally west of the Alleghenies as far north as Indiana county. Also reported from Lehigh, Huntingdon, and Bedford counties.

HABITAT—It occurs in rich bottomlands, often near streams, and also in rather moist fertile uplands.

IMPORTANCE OF THE SPECIES—It reaches dimensions so that it can produce lumber of commercial size and quantity, but other superior species will grow in the same place and consequently it cannot be recommended for forestry purposes. It is, however, one of the most attractive ornamental oaks and deserves to be planted extensively for such purposes.

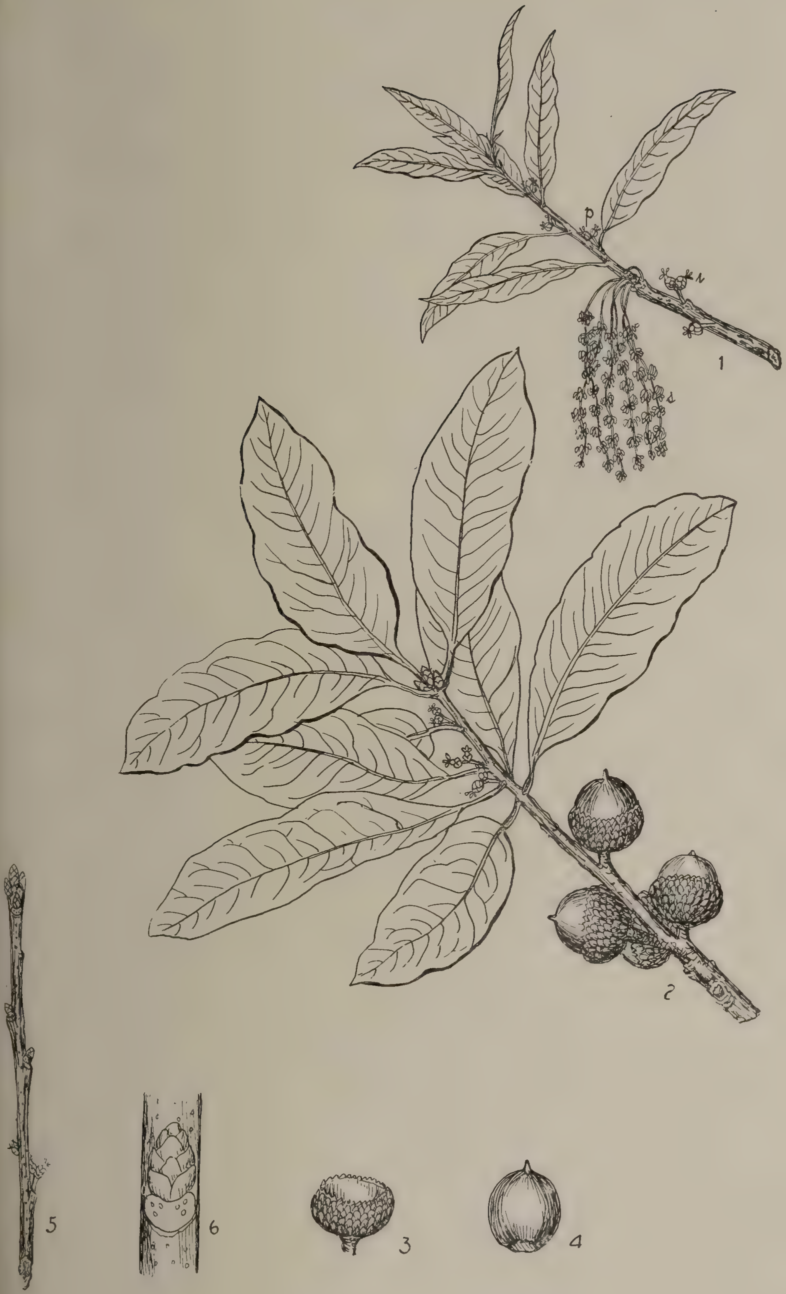

PLATE LXIX. LAUREL OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with buds, lenticels, pentangular pith, and immature acorns, x ½.
6. Section of winter twig, enlarged.

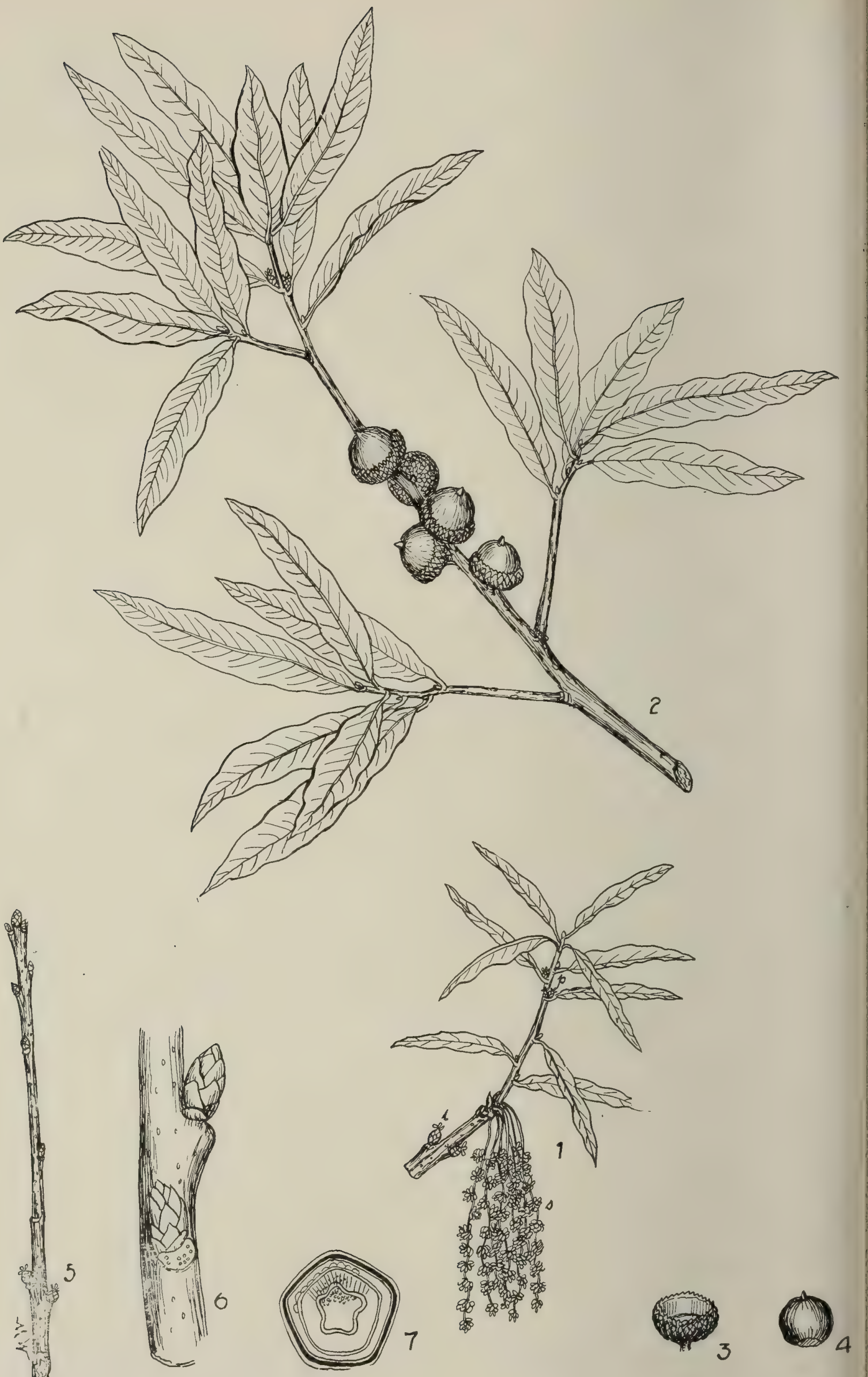

PLATE LXX. WILLOW OAK.

1. Flowering branch with immature leaves, (s) staminate blossoms, (p) pistillate blossoms, (i) immature acorns, x ½.
2. Branch with mature leaves, immature and mature acorns, x ½.
3. An acorn cup, x ½.
4. An acorn, x ½.
5. Winter twig with buds, lenticels, and immature acorns, x ½.
6. Section of winter twig, enlarged.
7. Cross section of twig showing pentangular pith, wood with conspicuous medullary rays, and bark, enlarged.

WILLOW OAK.

Quercus phellos, Linnaeus.

FORM—This tree usually attains a height of 50-60 ft. with a diameter of 1½-2 ft., but may reach a height of 80 ft. with a diameter of 4 feet. Crown usually narrow, rather open, pyramidal and round-topped.

BARK—Reddish-brown, ½-¾ of an inch thick, shallowly fissured and scaly.

TWIGS—Rather stout, smooth and shining during first winter, reddish-brown to dark brown.

BUDS—Alternate, ovate, about ⅛ of an inch long, strongly angled, sharp-pointed, covered by loosely overlapping dark brown scales which are slightly serrated on the margin.

LEAVES—Alternate, narrowly elliptic, sometimes lanceolate, narrowed at apex and base, 2-5 inches long, ½-1 inch wide, entire or with slightly wavy margins; terminated by a sharp bristle-pointed apex.

LEAF-SCARS—See "Leaf-Scars" under White Oak, page 132.

FLOWERS—Appear about May when leaves are ⅓ developed. Staminate flowers slender, hairy, yellowish, 2-3 inches long. Pistillate flowers borne on smooth slender stalks.

FRUIT—An acorn, maturing at the end of the second season, usually solitary, sessile or nearly so. Nut hemispheric, ½ inch in diameter, pale yellow-brown, sometimes striate. Cup saucer-shaped, covers only a small portion of the base of the nut and is covered with close, thin, hairy, reddish-brown scales. Kernel is very bitter and yellowish in color.

WOOD—Ring-porous; with conspicuous medullary rays; strong, coarse-grained, rather soft and light brown. Weighs 46.56 lbs. per cubic foot. Used for fuel and to a limited extent for general construction and felloes in wagon wheels.

DISTINGUISHING CHARACTERISTICS—The Willow Oak, also known as the Peach Oak, Water Oak, Swamp Oak, and Pin Oak, may readily be distinguished from all the other oaks of Pennsylvania except the Laurel Oak by its characteristic leaf, which resembles the leaf of a willow rather than the typical oak leaf. The Laurel Oak is the only other oak which bears a leaf that shows any resemblance, but its leaf is longer and broader, more obtuse-pointed, and hairy beneath. The cups of the acorns of this species are flatter and the acorns smaller than those of the Laurel Oak. The buds of this species are dark chestnut-brown in color, while those of the Laurel Oak are light brown and not angular.

RANGE—From New York to Florida, westward to Kentucky, Missouri, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found only in the southeastern part of the State. Reported from Bucks, Chester, Delaware, Lancaster, and Philadelphia counties.

HABITAT—Usually found on wet sandy soil, and occurs frequently along swamps and streams, but occasionally is found on higher areas where it may reach a fair size.

IMPORTANCE OF THE SPECIES—This species is so limited in its natural distribution in this State and its wood is of so little commercial importance that it cannot be considered of forestal value. It should not be planted for forestry purposes but deserves to be planted ornamentally, especially in parks and along avenues. It hybridizes with several species of other Oaks, especially the Red Oak, and these hybrids are often very attractive ornamentally.

THE NETTLE FAMILY—URTICACEAE.

This family contains a great number of representatives, the majority of which are tropical. It contains trees, shrubs, and many other small plant forms. The trees and shrubs alone comprise over 1,000 species and are found in the temperate and tropical regions of both hemispheres. They grow usually at relatively low altitudes frequenting wet and swampy as well as dry and arid habitats.

Several representatives of this family are important timber trees while others are of less commercial importance. Occasionally they may form pure stands but usually are mixed with other species. This family also contains representatives which are attractive ornamentally and used for hedges.

The leaves are simple, alternate, and usually deciduous. The fruit matures in one season, in some species in spring shortly after the blossoms while in others in fall. The seeds may germinate the same season or lie dormant over winter and germinate the following spring. The fruit of some genera is edible. It is very variable in form and structure. The subjoined key based primarily on fruit will aid in distinguishing the genera of this family native to Pennsylvania:

KEY TO THE GENERA.

Page.

1. Fruit a berry; pith chambered, ... **Celtis** 152
1. Fruit not a berry, pith not chambered, ... 2

2. Fruit dry, a samara, winged all around; flowers mostly polygamous, sap not milky, ... **Ulmus** 149
2. Fruit not dry, an achene, not winged; flowers unisexual; sap milky, ... 3

3. Fruit elongated, edible; leaves dentate 3-nerved; branches unarmed; both staminate and pistillate flowers in separate spikes, ... **Morus** 154
3. Fruit round, not edible; leaves entire; branches armed; staminate flowers in racemes, pistillate in heads, ... **Maclura** 153

THE ELMS—ULMUS (Tourn.) Linnaeus.

The members of this genus are usually trees, rarely shrubs. About 15 species are known of which number 6 species are native to North America and 2 to the State of Pennsylvania.

The leaves are simple, alternate, two-ranked, straight-veined, and unequal-based. The flowers may appear before or after the leaves. The 2 species native to this State produce their flowers early in spring before the leaves. The fruit of the native species ripens in spring shortly after the flowers have matured. It consists of a flat seed surrounded by a thin papery wing.

The trees yield valuable wood and some of them also produce a tough inner bark which is used for food, in medicine, and manufactured into ropes and coarse cloth. The Elms are not only valuable commercially but also attractive ornamentally. The native American Elm and the introduced English Elm (Ulmus campestris L.) are not only beautiful in summer when covered with a dense foliage but also in winter when the little twigs and branches, and the massive trunk and limbs stand out against the sky. The subjoined key will aid in distinguishing the two native species of Elm and the commonly introduced English Elm:

SUMMER KEY TO THE SPECIES.

	Page.
1. Leaves smooth above or nearly so; fruit ovate or oval, ciliate on margin; flowers on slender drooping stalks, ... U. americana	151
1. Leaves very rough above; fruit circular, not ciliate; flowers nearly sessile, ... 2	
2. Small to medium-sized native tree; inner bark mucilaginous; branchlets and pedicels downy; fruit densely brown-hairy over seed, ... U. fulva	150
2. Large introduced tree; inner bark not mucilaginous; branchlets and pedicels smooth; fruit smooth throughout, ... U. campestris	149

WINTER KEY TO THE SPECIES.

1. Bud-scales densely brown-hairy; inner bark mucilaginous; twigs grayish and rough, U. fulva	150
1. Bud-scales not densely brown-hairy; inner bark not mucilaginous; twigs not grayish nor rough, ... 2	
2. Buds chestnut-brown; bud-scales with darker margin; bark ridged; twigs without corky ridges; form of the tree decidedly deliquescent, ... U. americana	151
2. Buds smoky-brown to almost black; bud-scales rather uniform in color; bark rather firm, often roughened into oblong blocks; form of tree intermediate with an excurrent tendency, ... U. campestris	149

SLIPPERY ELM.

Ulmus fulva, Michaux.

FORM—A small to a medium-sized tree usually attaining a height of 40-60 ft. with a diameter of 1-2½ ft., but may reach a maximum height of 80 ft. with a diameter of 2½ feet. Crown broad and flat-topped. Limbs stout and ascending.

BARK—Thick, rough, longitudinally fissured, dark brown, tinged with red within. Inner bark fragrant, mucilaginous and slippery, whence its common name. See Fig. 66.

TWIGS—Rather stout, difficult to break on account of flexible bark, at first hairy and greenish, later smoother and grayish-brown, roughened by raised lenticels and raised leaf-scars.

BUDS—Alternate; terminal bud absent; ovate, about ¼ of an inch long, dark chestnut-brown, covered with about 12 overlapping bud-scales coated with rusty brown hairs. Flower-buds stout and located along side of twig while leaf-buds are relatively slender and located towards end of twig.

LEAVES—Alternate, simple, 5-7 inches long, oval to obovate, thick, dark green, rough on both sides, rounded and oblique at base, acute at apex, doubly toothed on margin.

LEAF-SCARS—Alternate, oval, raised, lighter than twig, contain usually 3 rather small and inconspicuous bundle-scars.

FLOWERS—Appear before the leaves from lateral propagative buds. The smaller vegetative buds located near the end of the twigs open later. Flowers are perfect and clustered on short stalks.

FRUIT—A short-stalked samara ½-¾ of an inch broad, consisting of a flat seed surrounded by a wing and maturing in spring a few weeks after the flowers have matured. The fruit is hairy only over the seed.

WOOD—Ring-porous; with rather indistinct medullary rays; pores of the summer wood arranged in tangentially concentric bands; pores of spring wood form a broad band of 3 or more rows. Wood is heavy, hard, strong, dark brown to red, coarse-textured, easy to split, very durable in contact with the soil. Weighs 45.35 lbs. per cubic foot. Used for posts, railway ties, slack cooperage, agricultural implements.

DISTINGUISHING CHARACTERISTICS—The Slippery Elm, also known as the Red Elm and Moose Elm, can be distinguished from the other Elms of Pennsylvania by its fragrant and mucilaginous inner bark and its dark chestnut-brown buds covered with rusty brown pubescence. It is a smaller tree than either the American or the English Elm. The leaves are rough in both directions while those of the American Elm are rough only in one direction. The bark is not so rough nor the buds so dark colored as those of the English Elm. Its lateral branches are rather straight while those of the American Elm are drooping.

RANGE—Valley of the St. Lawrence, south to Florida, and west to North Dakota and Texas.

DISTRIBUTION IN PENNSYLVANIA—Scattered locally throughout the State. Generally absent in the mountainous region. Most common in the valleys. Does not form pure stands.

HABITAT—It is commonly found on low rich soil, along streams, and on hillsides. In the southern part of Pennsylvania common on limestone outcrops.

IMPORTANCE OF THE SPECIES—This tree does not attain a large size nor grow in habitats where other more valuable species will not grow, consequently it cannot be recommended for extensive planting for forestry purposes. It may be recommended for limited planting in wet places, especially on the border of streams and on limestone outcrops.

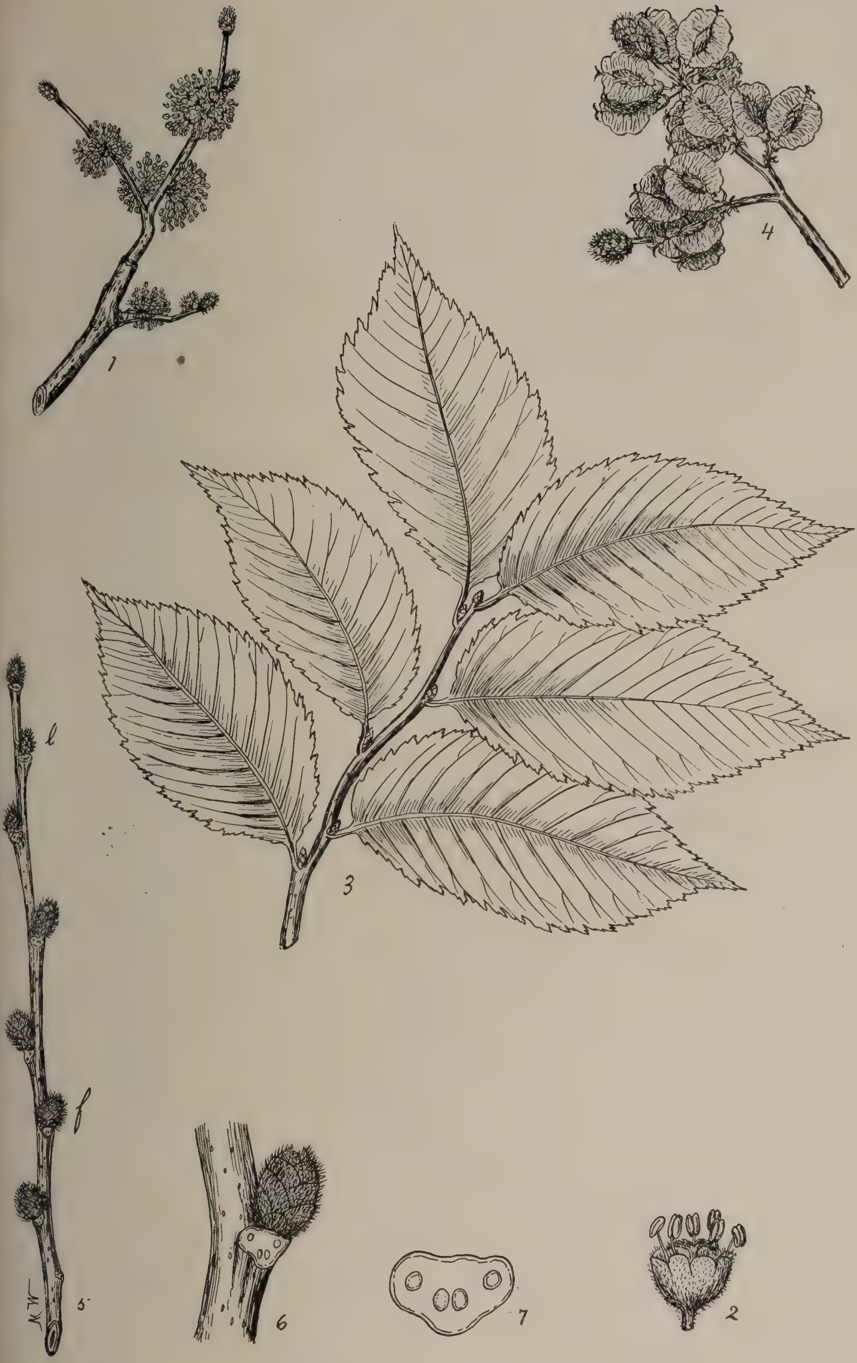

PLATE LXXI. SLIPPERY ELM.

1. A flowering branch, x ½.
2. A flower, enlarged.
3. Branch with mature leaves, x ½.
4. Branch with mature fruit and expanding leaf-buds, x ½.
5. Winter twig with (f) flower buds, and (l) leaf buds, x ½.
6. Section of a winter twig with a densely pubescent bud, enlarged.
7. A leaf-scar with bundle-scars, enlarged.

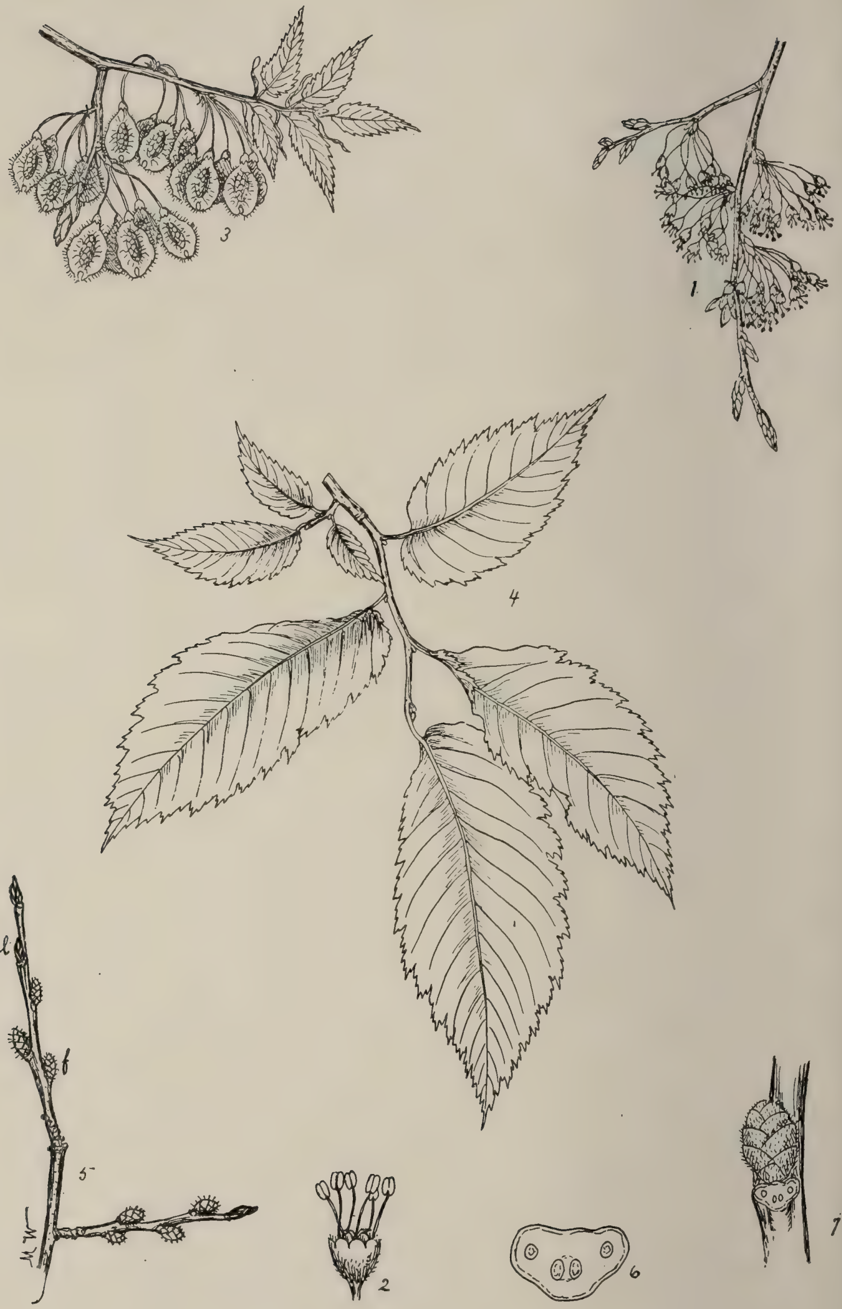

PLATE LXXII. AMERICAN ELM.

1. Flowering branch with leaf buds, x ½.
2. A flower, enlarged.
3. Branch with mature fruit, immature leaves and an expanding bud, x ½.
4. Branch with mature leaves, x ½.
5. Winter twig with (f) flower buds, and (l) leaf buds, x ½.
6. A leaf-scar with bundle-scars, enlarged.
7. Section of a winter twig with a slightly pubescent bud, enlarged.

AMERICAN ELM.

Ulmus americana, Linnaeus.

FORM—A large tree usually attaining a height of 80-100 ft. with a diameter of 2-4 ft., but may reach a height of 120 ft. with a diameter of 8-11 feet. A tree in Jefferson county, Pennsylvania, reached a height of 140 ft. and had a crown spread of 76 feet. It cut almost 9,000 board feet of lumber. The form is very variable. The most common kinds which are recognized are "Vase Form," "Umbrella Form," "Oak Form," and "Feathered Form." Some trunks are tall and straight terminated by a shallow but broad crown composed of very gracefully drooping lateral branches. In open grown trees, the trunk often divides near the ground. The form may resemble the spray of a fountain. See Fig. 35.

BARK—Rather thick, grayish whence its name Gray Elm, rougher by long and irregular furrows separating rather broad, flat ridges which are usually firm but occasionally flaky or corky. Cross-section of bark often shows alternating white and brown layers.

TWIGS—Slender, at first greenish and pubescent, later smooth and reddish-brown, roughened by leaf-scars and pale, inconspicuous, scattered lenticels. Base of twigs marked with persistent ring-like bud-scale scars.

BUDS—Alternate; terminal bud absent; ovate, sharp-pointed, slightly flattened, reddish-brown, usually smooth, rarely slightly hairy, covered with about 6-10 overlapping reddish-brown scales with darker margin. Leaf-buds are smaller than the flower-buds and located toward end of twig. Flower-buds are larger and located along side of twig. Buds are usually located above one end of leaf-scar.

LEAVES—Alternate, simple, ovate, 4-6 inches long, thick, rough, unequally based, acute at apex, doubly-toothed on margin. Primary veins run straight from midrib to points of the teeth.

LEAF-SCARS—Alternate, 2-ranked, elevated, semi-circular, with corky surface, marked with three equidistant bundle-scars which may be compounded and are usually sunken.

FLOWERS—Appear before the leaves from lateral propagative buds. Flowers occur in 3-4-flowered clusters on drooping stalks about 1 inch long. They are perfect with greenish calyx, reddish anthers, and light green styles.

FRUIT—An oval samara, about ½ of an inch long, borne on a slender stalk; consists of a flat seed surrounded by a wing which is terminally deeply notched and ciliated on margin. Matures early in spring shortly after flowers.

WOOD—Somewhat similar to Slippery Elm, page 150, but differs slightly. Weighs 40.54 lbs. per cubic foot, is lighter in color than Slippery Elm, and has its pores in spring wood in a narrow band of usually less than 3 rows. Its wood has a wider range of usefulness.

DISTINGUISHING CHARACTERISTICS—The American Elm, also known as White Elm, Gray Elm, and Water Elm, can readily be recognized by its leaves which are smooth on the upper surface, and by the oval fruit with ciliate margin. The flowers occur on slender drooping stalks. The buds are only slightly pubescent and covered with the chestnut-brown scales. The form and method of branching are very distinctive. Also see "Distinguishing Characteristics" under Slippery Elm.

RANGE—Few trees have so large a range. It extends from Newfoundland across Canada to the Rocky Mountains a distance of almost 3,000 miles and south to Florida and Texas, a distance of 1,200 miles.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State. Most common in the well watered portions. Less frequent in the mountainous parts.

HABITAT—Prefers rich moist bottomlands. Is commonly found along streams, bordering lakes and ponds, and in rich alluvial soil. Usually mixed with other hardwoods.

IMPORTANCE OF THE SPECIES—The American Elm is the most valuable of all the Elms on account of its wide distribution, large size, valuable wood, and magnificent form. Michaux called it "the most magnificent vegetable of the temperate zone." It has not been planted much for forestry purposes but deserves to be planted, especially on rich soil which may be too wet for agriculture. It must be planted close in order to prevent the development of lateral branches.

HACKBERRY.

Celtis occidentalis, Linnaeus.

GENUS DESCRIPTION—The genus Celtis comprises about 60 species, of which number about 9 are native to North America and 1 to Pennsylvania. Representatives of this genus are found in temperate and tropical regions of both the eastern and western hemispheres. Another species known as Rough-leaved Hackberry (Celtis crassifolia, Lamarck) is also reported from 3 counties in this State. The leaves of the latter are very rough and the fruit is subglobose.

FORM—Usually a small tree 20-35 ft. in height, but single specimens with a height of 80 ft. and a diameter of 30 inches have been reported for this State. In the South it becomes larger. Trunk usually short. Crown rather wide-spreading and round-topped. Witches' brooms are frequently found upon it.

BARK—Grayish-brown, sometimes as smooth as Beech bark, others have very rough bark due to harsh, warty projections. Younger branches are dark brown to reddish-brown in color. See Fig. 102.

TWIGS—Slender, somewhat shiny, occasionally slightly downy, brownish, covered by scattered raised and often longitudinally-elongated lenticels; contain chambered white pith.

BUDS—Alternate, 2-ranked, small, often malformed and swollen, ¼ of an inch long, ovate, sharp-pointed, appressed, covered with 3-4 visible and closely overlapping bud-scales. Bud-scales sometimes longitudinally-striated and dark margined. Swollen buds caused by insects.

LEAVES—Alternate, simple, ovate, 2-4 inches long, acute at apex, obliquely rounded at base, serrate on margin, entire near base, rough on upper surface, with prominent primary veins. Petioles slender, slightly hairy and grooved.

LEAF-SCARS—Alternate, 2-ranked, small, semi-oval, at or almost at right angles to twig on projections of twig, with 1-3 bundle-scars.

FLOWERS—Appear about May. Three kinds, staminate, pistillate, and perfect, may be found. They are greenish and borne on slender drooping stalks.

FRUIT—A berry-like, dark purple, globular drupe about ¼-½ of an inch in diameter, tipped with persistent style and borne on a slender stalk. Matures about September and often persists into winter.

WOOD—Ring-porous; rays very distinct; pores in summer wood arranged in tangentially wavy bands; heavy, not strong, coarse-grained, yellowish. Weighs 45.51 lbs. per cubic foot. Used for fencing, crates, boxes, slack cooperage, hoe handles, agricultural implements. Resembles Ash. Most mills sell it as Ash.

DISTINGUISHING CHARACTERISTICS—The Hackberry, also known as Sugarberry, Nettle-tree, Hoop Ash, and Hack-tree, can be distinguished by its chambered pith, berry-like fruit, warty or corky bark and disfigured twigs and buds. Abnormally swollen twigs are due to stings of gall insects. Witches' brooms are also common and very distinctive. The leaves resemble those of the Elms only are sharper pointed.

RANGE—Its range covers about 2,000,000 square miles in the United States, extending over the major part of the United States east of the Rocky Mountains.

DISTRIBUTION IN PENNSYLVANIA—Occasional throughout the State. Nowhere abundant. Sometimes only a single tree is known in a locality. Large specimens are found in Northampton and Montgomery counties.

HABITAT—Prefers rich moist soil, but also grows on gravelly uplands. Does not form pure stands, but usually occurs solitary.

IMPORTANCE OF THE SPECIES—The Hackberry is of little commercial importance in this State since it is a rare tree and seldom reaches a large size. Only a few large trees have been recorded in this State. It cannot be recommended as a timber tree, neither has it any specially attractive ornamental qualities. Its continuity is insured because the birds carry the seed far and wide.

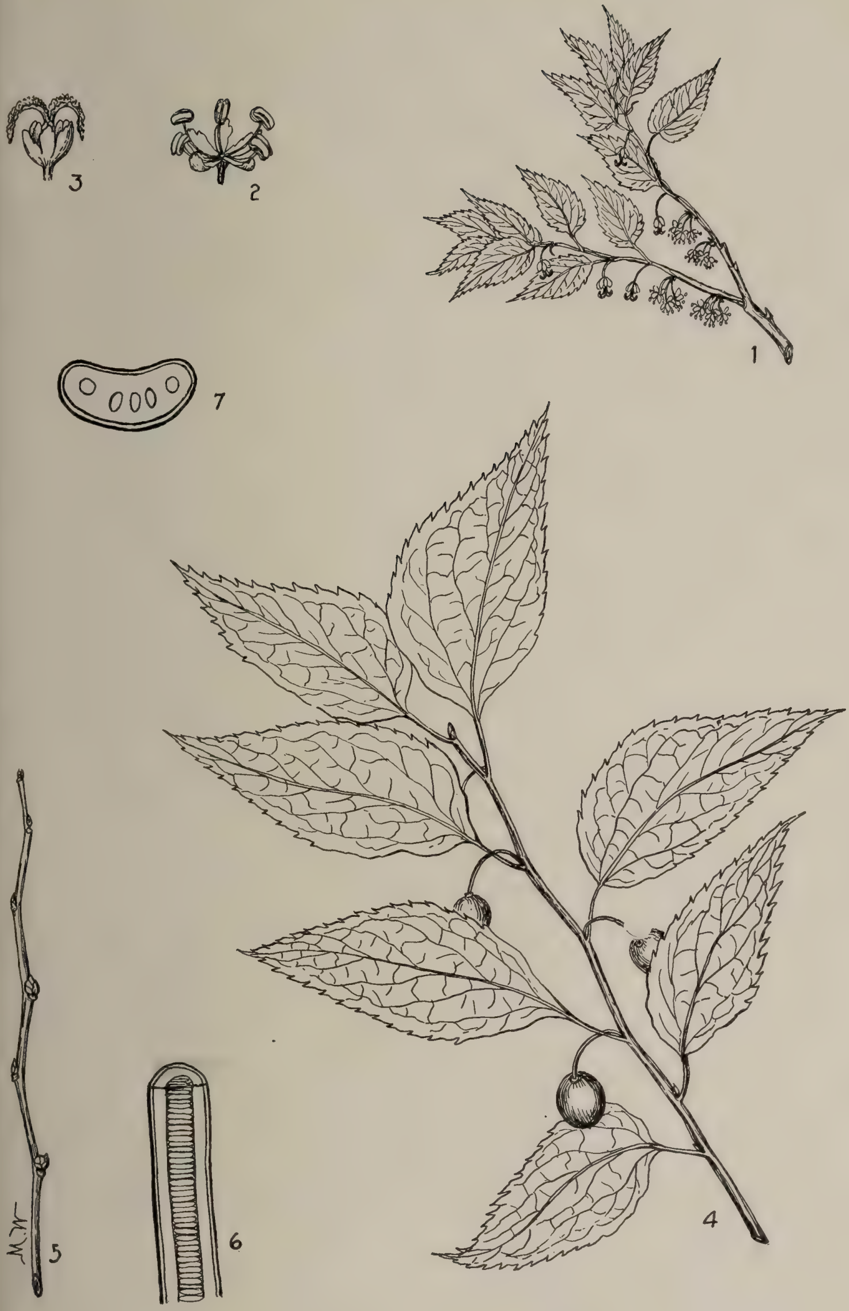

PLATE LXXIII. HACKBERRY.

1. Branch with immature leaves, staminate and pistillate flowers, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. A branch with mature leaves and mature fruit, x ½.
5. A winter twig, x ½.
6. Section of a winter twig showing chambered pith, enlarged.
7. A leaf-scar with bundle-scars, enlarged.

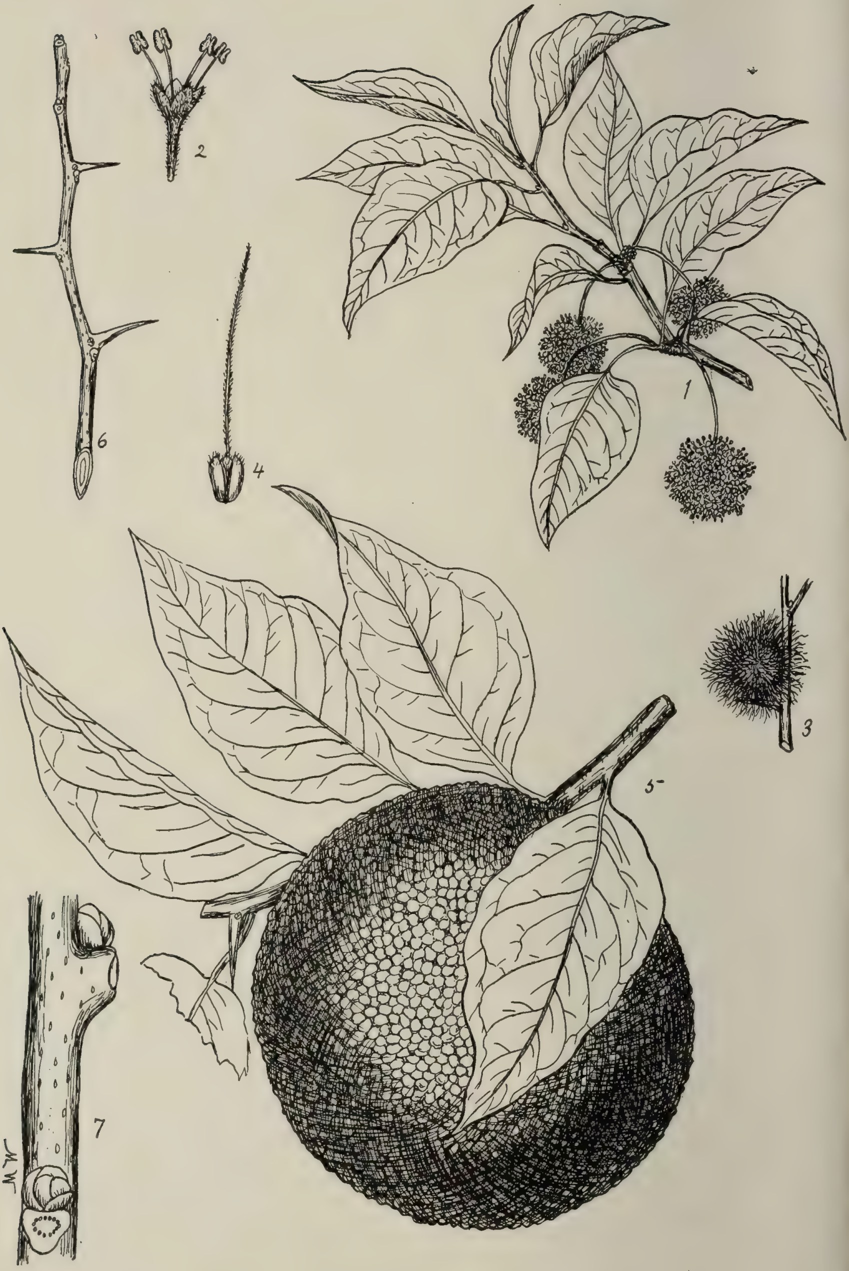

PLATE LXXIV. OSAGE ORANGE.

1. Branch with immature leaves and heads of staminate flowers, x ½.
2. A staminate flower, enlarged.
3. Branch with a head of pistillate flowers, x ½.
4. A pistillate flower, enlarged.
5. Branch with mature leaves and a single mature fruit, x ½.
6. A winter twig with three thorns, x ½.
7. Section of a winter twig showing lenticels, buds, and leaf-scars with bundle-scars, enlarged.

OSAGE ORANGE.

Maclura pomifera, (Raf.) Schneider.

GENUS DESCRIPTION—The species described on this page is the sole representative of this genus.

FORM—A small or medium-sized tree usually attaining a height of 20-40 ft. with a diameter of 12 inches but reaches a height of 50-60 ft. with a diameter of 2-3 feet. Trunk usually short, stout, often covered with dense growth of sprouts. Crown round-topped, rather open, often irregular. Branches in interior of crown often covered with stiff, spiny, and interlacing branchlets.

BARK—On older trunks rough, dark gray, about ¾-1 inch thick, longitudinally and sometimes diagonally furrowed, with prominent ridges which scale off into thin close-fitting scales. On branches it is thinner, pale brown tinged with yellow. Branches are often armed with straight axillary spines and contain yellow pith.

TWIGS—Alternate, rather stout, at first greenish and slightly pubescent, later yellowish-brown, contain yellow pith, marked by pale yellow lenticels. Younger branches are often armed with stout, straight, axillary spines and stout, spur-like, lateral branchlets.

BUDS—Alternate; terminal bud absent; equal-sized, broad, circular, with 5-7 small chestnut-brown scales.

LEAVES—Alternate, simple, about 4 inches long and 2½ inches wide, ovate in outline, wedge-shaped at base, acute at apex, entire on margin, dark green above, pale green below.

LEAF-SCARS—Alternate; located on twig enlargement at nodes; small to medium-sized, broadly triangular to elliptical, contain usually 1 or 3 bundle-scars, sometimes more.

FLOWERS—Appear about June when leaves are almost fully developed. Staminate flowers arranged in racemes on long slender drooping stalks; pistillate in dense heads with short stalks. Ovary is terminated by a long, slender, hairy style.

FRUIT—Pale green, orange-like in appearance, 4-5 inches in diameter, composed of many small drupes which are closely grown together. When punctured exudes a milky juice which turns black upon exposure.

WOOD—Ring-porous; rays rather inconspicuous; golden-yellow in color, streaked vertically with red stripes; heavy, very hard and strong, very durable. Weighs 48.21 lbs. per cubic foot. Used for fence posts, wagon felloes and rims, bridge piling, insulator pins, police clubs, rustic chairs, and tobacco pipes.

DISTINGUISHING CHARACTERISTICS—The Osage Orange, also known as Bowwood, Osage Apple-tree, Yellow-wood, and Hedge-tree, can be distinguished by its large orange-like green fruit. The twigs are armed with stout straight axillary spines, contain a milky juice and thick orange-colored pith and are covered with a light brown bark sometimes tinged with orange. The leaves are alternate, simple, and entire. Wood is very hard and orange to brown in color with light yellow sapwood.

RANGE—Oklahoma south to Dallas, Texas. Also reported from Arkansas. To date it has been planted in possibly every State in the Union.

DISTRIBUTION IN PENNSYLVANIA—Introduced in practically every part of the State as a hedge or ornamental tree.

HABITAT—It is less exacting in soil than most of our trees, but when it has the privilege it chooses the best. In its natural range it thrives best on the black fertile flats, and rarely occurs on sandy soil. Occasionally found in swamps. Originally found in small pure stands.

IMPORTANCE OF THE SPECIES—The Osage Orange is not native to Pennsylvania but has been planted extensively for hedge and ornamental purposes. No wood is more valuable for fence posts. We have other trees which are more attractive as a hedge and the thorns which the tree bears are also objectionable when it is used as a hedge. It is difficult to eliminate it from an area where it has established itself.

RED MULBERRY.

Morus rubra, Linnaeus.

GENUS DESCRIPTION—The genus Morus comprises about 10 species of which number 3 are native to North America and 1 to Pennsylvania. Its representatives occur as trees or shrubs in eastern North America, Central America, South America, and Europe but are most abundant in Asia. The White Mulberry (Morus alba L.), a native of Asia, has been planted extensively in this State.

FORM—Usually attains a height of 35-50 ft. with a diameter 12-18 inches but may reach a height of 70 ft. with a diameter of 3 feet. Largest in Ohio and Mississippi valleys. Trunk usually short, subdividing near the ground. Crown usually broad, round-topped, and dense.

BARK—Begins to roughen about third year by splitting longitudinally or diagonally. On older trunks rather thin, dark grayish-brown, peels off in long narrow flakes which somewhat resemble the flakes of Catalpa. See Fig. 55.

TWIGS—Stout, smooth, glossy or occasionally dull, slightly zigzag, greenish-brown tinged with red, enlarged at nodes to bear buds and leaves, covered with few scattered inconspicuous lenticels, roughened at base of season's growth by ring-like bud-scale scars. A milky juice is excreted from twigs if they are cut or punctured.

BUDS—Alternate; terminal bud absent; ovate, round in cross-section, sharp-pointed, about 2/5 of an inch long, slightly divergent and laterally inclined, covered by 3-9 exposed bud-scales which are 2-ranked, greenish-brown to greenish-red with darker margin. Buds are located on twig enlargements. A bud is often found at end of twig; it is not a terminal bud but an axillary one sometimes called a pseudo-terminal bud which means a false terminal bud.

LEAVES—Alternate, simple, ovate, 3-5 inches long, often cordate at base, serrate on margin, acute at apex, usually with 3 primary veins, except in lobed forms where more may be present. Usually not lobed but occasionally glove-form, 3-lobed or 5-lobed. Leaves are slightly rough on upper surface.

LEAF-SCARS—Alternate, 2-ranked, raised on twig enlargements, hollow or concave, almost circular, with raised bundle-scars arranged in an ellipse or distributed irregularly over leaf-scar.

FLOWERS—Appear May or June. Staminate flowers occur in narrow spikes about 2 inches long originating in axils of prospective or developing leaves on short hairy green stalks. Pistillate flowers occur in dense spikes about 1 inch long. Occasionally the staminate and pistillate are slightly mixed on a spike.

FRUIT—Appears about July. Compound or aggregate, about 1 inch long, composed of many small drupes, at first green, later red, finally dark purple, juicy, sweet and edible.

WOOD—Ring-porous; pores in summer wood small in groups of 3-6; rays usually quite distinct; orange yellow to yellowish-brown, with thin nearly white sapwood; soft, not strong, durable in contact with soil. Weighs 36.75 lbs. per cubic foot. Used for fence posts, scythe snaths, cooperage, boat building.

DISTINGUISHING CHARACTERISTICS—The Red Mulberry, also known as simply Mulberry and sometimes Black Mulberry, can be distinguished by its large alternate 2-ranked greenish-brown buds with darker colored bud-scale margins, by its 3-veined leaves which have their veins sunken on upper surface, and are usually rough on the upper surface. The milky juice of the twigs and its peculiar flowers and fruit are distinctive. The leaves are occasionally lobed. In winter the elevated and hollowed leaf-scars with bundle-scars arranged in an ellipse are characteristic.

RANGE—Massachusetts to Florida, west to Kansas and Nebraska.

DISTRIBUTION IN PENNSYLVANIA—Local and sparse in the eastern and southern parts, occasional in the central part and rare in mountainous parts.

HABITAT—Prefers rich moist soil. Most common in valleys and on foothills. Usually mixed with other hardwoods.

IMPORTANCE OF THE SPECIES—The Red Mulberry does not produce wood of any special commercial importance because it is nowhere abundant and does not reach a large size. It is used for fence posts because it is durable in contact with the soil. The wood resembles Black Walnut when polished, only is somewhat lighter. It produces a pleasing effect when made up into furniture. It cannot be strongly recommended for forestry purposes but it is an excellent ornamental tree and also furnishes food for birds.

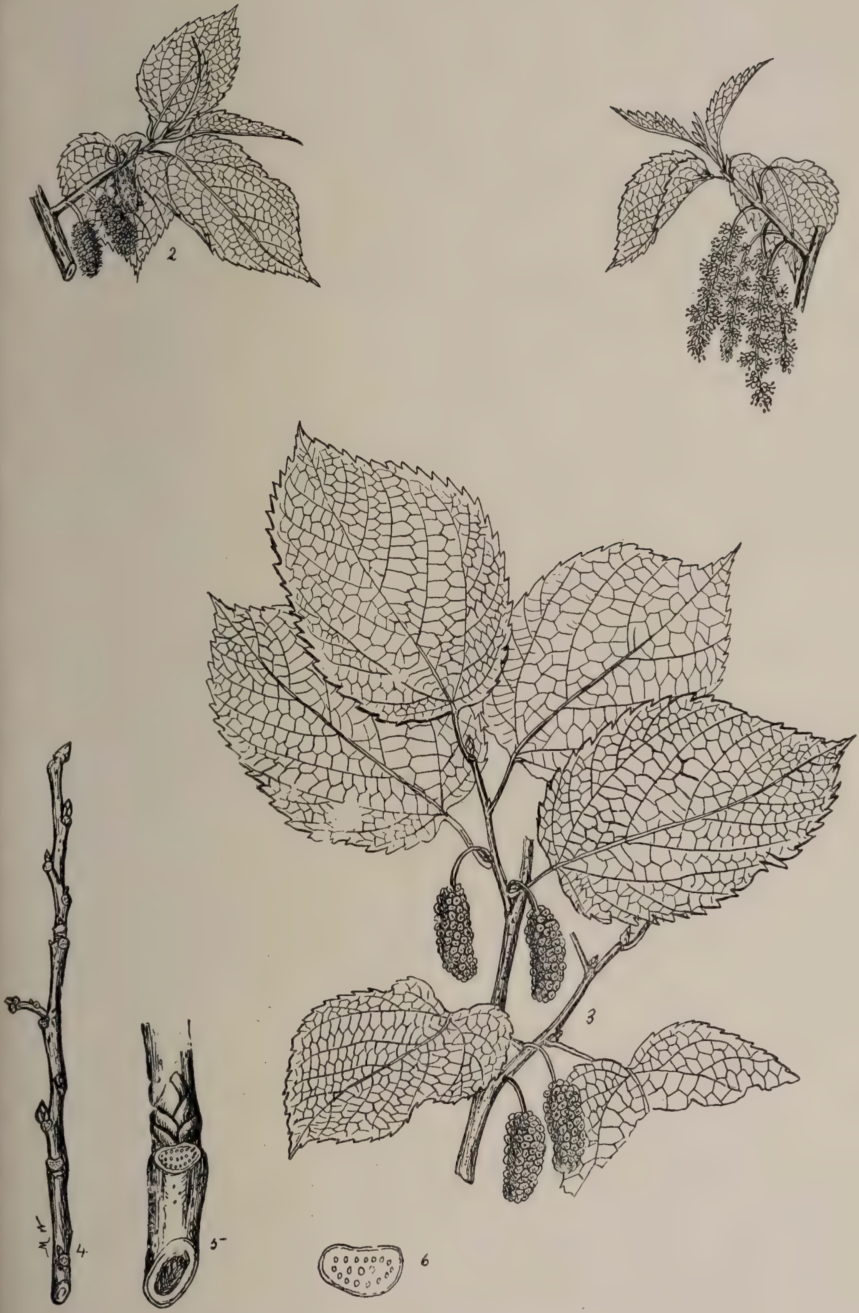

PLATE LXXV. RED MULBERRY.

1. Branch with immature leaves and four staminate flower spikes, x ½.
2. Branch with immature leaves and three pistillate flower spikes, x ½.
3. Branch with mature leaves and mature fruit, x ⅓.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.
6. A leaf-scar with bundle-scars, enlarged.

THE MAGNOLIA FAMILY—MAGNOLIACEAE.

The Magnolia family comprises about 10 genera with about 85 species of trees and shrubs, which are widely distributed in temperate and tropical regions. The flora of North America embraces 4 genera, 2 of which comprise only shurbs while the other 2 contain some of our well-known and important timber trees. The 2 arborescent genera, Magnolia and Liriodendron, include about 9 species in North America. Both genera are represented in the flora of Pennsylvania, the former with 3 species and the latter with 1 species.

KEY TO THE GENERA.

Page.

1. Leaves not lobed; fruit a cone of fleshy coherent follicles; buds ovate to conical, sharp-pointed, hairy at least within; leaf-scars lunate to oval usually with 3, sometimes many, bundle-scars, ...Magnolia 155

1. Leaves 4-lobed or 6-lobed; fruit a spindle-shaped cone of dry carpels; buds flattened, oblong, blunt-pointed, smooth both on outside and inside; leaf-scars circular or sometimes slightly flattened at top with many scattered bundle-scars, Liriodendron 159

THE MAGNOLIAS—MAGNOLIA, Linnaeus.

The Magnolias are among the most beautiful trees native to the State of Pennsylvania. All the Magnolias have the appearance of tropical trees and in fact most of them do not venture far beyond warm latitudes. Their large, entire-margined, pinnately veined leaves and their large, solitary and conspicuous flowers are largely responsible for their tropical appearance. This genus derived its name from Pierre Magnol, a French botanist, who was sometime Professor of Botany in Montpellier and died in 1715. It embraces about 25 species of trees and shrubs 3 of which are native to Pennsylvania. The members of this genus are natives of eastern North America, southern Mexico, the West Indies, and eastern and central Asia.

SUMMER KEY TO THE SPECIES.

Page.

1. Leaves crowded at the end of the flowering branches in an umbrella-like circle, and 12-24 inches long, ...M. tripetala 158

1. Leaves scattered along the branches, and 3-12 inches long, ...2

2. Large tree; leaves 4-12 inches long and deciduous; flowers green to yellow; follicles rounded, ...M. acuminata 157

2. Small tree or shrub; leaves 3-6 inches long, glaucous on under side, often persistent; flowers white; follicles tapering or tipped with styles, ...M. virginiana 156

WINTER KEY TO THE SPECIES.

1. Buds 1-2 inches long and smooth on outside; leaf-scars large; twigs stout, M. tripetala 158

1. Buds less than 1 inch long, silky to almost smooth on outside; leaf-scars small; twigs slender, ...2

2. Large tree; leaves deciduous; twigs brown; bark furrowed and flaky; buds blunt-pointed, densely downy, ...M. acuminata 157

2. Small tree or shrub; leaves may persist; twigs green; bark smooth; buds green, pointed, hairy to smooth, ...M. virginiana 156

LAUREL MAGNOLIA.

Magnolia virginiana, Linnaeus.

FORM—Usually a small tree or shrub seldom exceeding a height of 25 ft. but in the south, particularly in Florida, may attain a height of 75 ft. with a diameter of 3 feet. In Pennsylvania rather small. Trunk usually short, often much swollen at the base.

BARK—On old trunks thin, gray, smooth to scaly; on young stems light gray to white and smooth.

TWIGS—Green, round, bitter, relatively slender, downy, later reddish-brown, roughened by broadly crescent-shaped leaf-scars. Pith has a tendency to become chambered.

BUDS—Alternate, bright green, 2/5-3/5 of an inch long, circular in cross-section, pointed, decidedly hairy, covered by successive pairs of stipules. Each pair of stipular scales envelopes the leaf just above it.

LEAVES—Alternate, simple, oval to broadly lanceolate, 3-6 inches long, obtuse at apex, tapering at base, entire on margin, glaucous beneath. Fall off in autumn in the North but persist in the South. Persist until spring in Franklin county, Pennsylvania.

LEAF-SCARS—Alternate, scattered along twig, narrow, oval to crescent-shaped, with its bundle-scars arranged in a broad U-shaped line.

FLOWERS—Appear the latter part of May in this State. Complete, solitary, globular, white, calyx and corolla of same color, about 2 inches long, and very fragrant.

FRUIT—Matures about October. Cone-like, fleshy to dry, scarlet, oval, about 2 inches long, composed of coherent follicles. Seeds are red, shiny, drupe-like and suspended at maturity by a thin long cord.

WOOD—Similar to that of the Cucumber Tree, page 157, except that its rays are higher and more crowded on the cross-section than those of the Cucumber Tree. Produces wood of commercial size only in the South. Weighs 31.38 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Laurel Magnolia, also known as Small Magnolia, or Sweet Bay, can be distinguished by its leaves which are scattered along the branches, 3-6 inches long, oval, obtuse, and glaucous beneath. The leaves of both the other native species are larger. The flowers are globular and white while those of the Cucumber Tree are slender-bell-shaped and greenish tinged with yellow, and those of the Umbrella Tree are only slightly scented. The leaf-buds are silky while those of the Umbrella Tree are smooth or slightly hairy. Its small size will also aid in distinguishing it. The "Distribution in Pennsylvania" of the three native species will also aid in identifying them.

RANGE—Eastern Massachusetts, south to Florida, extending west to Caledonia near Chambersburg, Pennsylvania, central North Carolina and through the Gulf States to Texas and southern Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Found only in the southeastern part of the State. Recorded from every county southeast of a line drawn through Northampton, Lehigh, Lebanon, Cumberland and Franklin counties. Its western limit is at Caledonia near Chambersburg in Franklin county.

HABITAT—Prefers swamps and wet places. Found along creeks or in bottomlands adjoining creeks, lakes, or ponds. Often a low shrub under moisture-seeking trees like Red Maple, Yellow Birch, Black Gum, White Oak, Hemlock, White Pine, and Tulip Tree. Its associates often are Rhododendron and Mountain Laurel.

IMPORTANCE OF SPECIES—This species is of no commercial importance in Pennsylvania because of its small size, limited distribution, slow growth, and inferior wood. It is extremely attractive and may be classified among our most beautiful native shrubs. It is well adapted for ornamental planting, only it grows rather slowly.

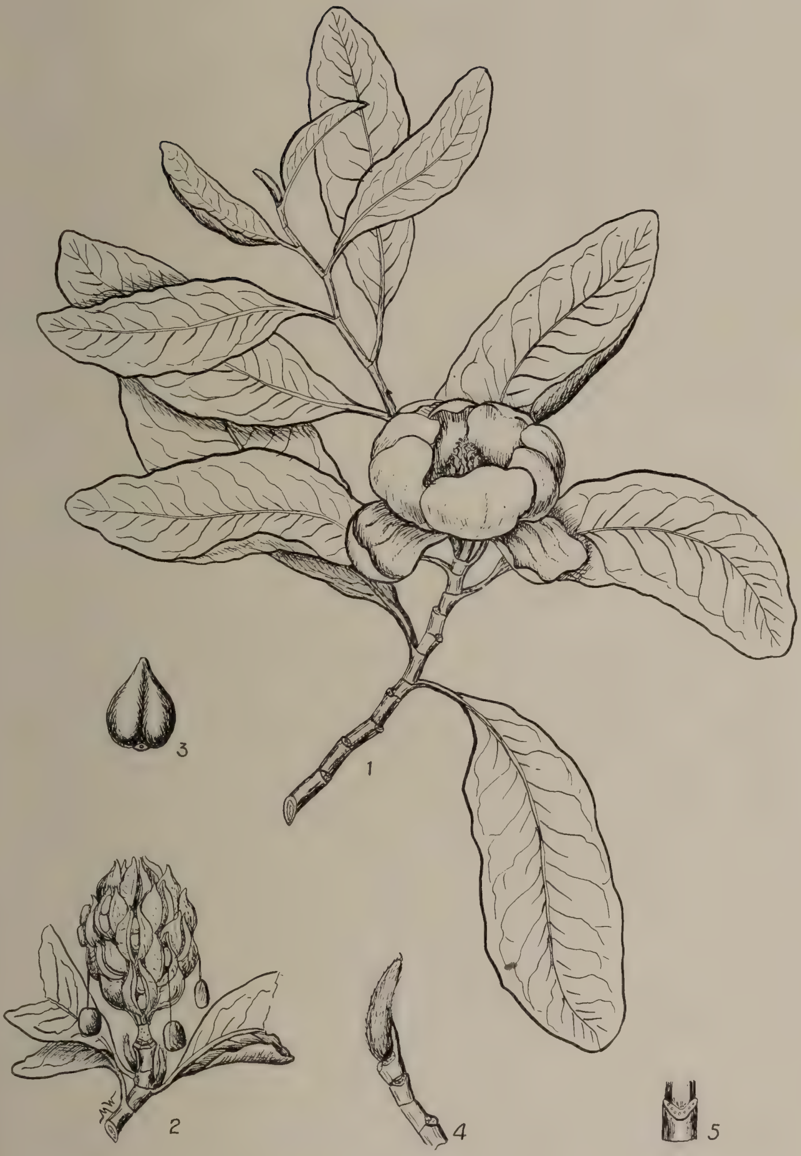

PLATE LXXVI. LAUREL MAGNOLIA.

1. A flowering branch with mature and developing leaves, x ½.
2. A fruiting branch with a portion of the leaves removed, x ½.
3. A seed, natural size.
4. A winter twig, x ½.
5. Section of a winter twig showing a leaf-scar with bundle-scars, natural size.

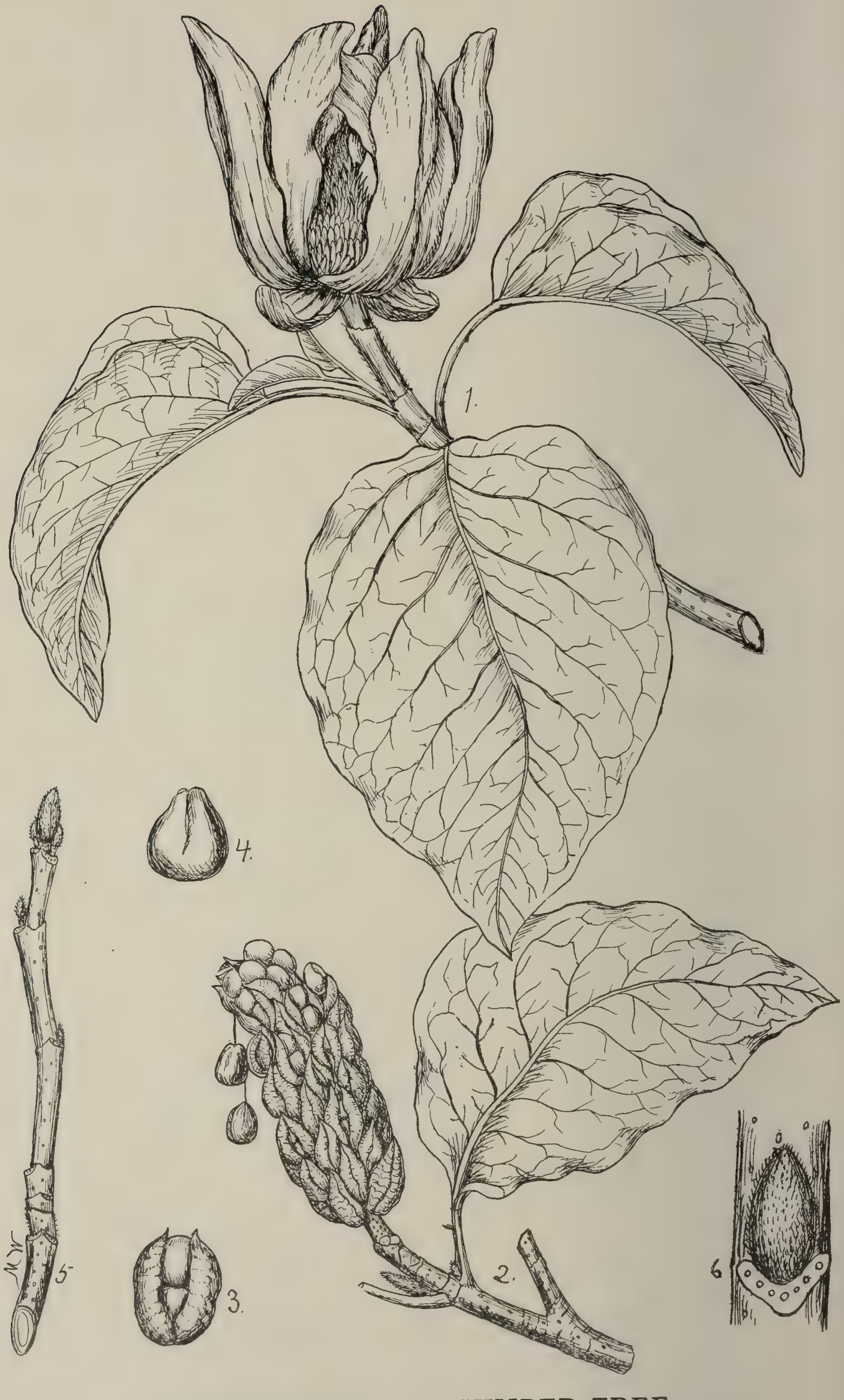

PLATE LXXVII. CUCUMBER TREE.

1. A flowering branch with mature and developing leaves, x ½.
2. Branch with a cone-like fruit, seeds hanging by threads, and a mature leaf, x ½.
3. A carpel just starting to open, showing two seeds on the inside, natural size.
4. A seed, enlarged.
5. A winter twig, x ½.
6. Section of a winter twig showing a bud and a leaf-scar with bundle-scars, enlarged.

CUCUMBER TREE.

Magnolia acuminata, Linnaeus.

FORM—A large tree, which may attain a height of 90 ft. with a diameter of 3-4 feet. The form of the forest grown tree is distinct from the open grown. Open grown specimens have a pyramidal crown with limbs originating all along the trunk from near the base to the narrow top. Lateral branches are wide-spreading and rather horizontal near the base, ascending and short at the top. Forest grown specimens have straight, slightly tapering, rather smooth trunks which are free from branches often for 50 ft. from the ground.

BARK—Grayish-brown to brown, with long furrows separating long, rather loose, scaly ridges. See Fig. 85.

TWIGS—Usually slender, round, usually smooth but sometimes slightly hairy, shiny, bitter, covered with a few orange-colored inconspicuous lenticels, and contain white pith which may show a tendency to become chambered.

BUDS—Alternate, circular in cross-section, densely covered with thick, pale, silky hairs, terminal buds about 2/5-4/5 of an inch long and oblong; lateral buds ⅛-¼ of an inch long, blunt-pointed, nearly surrounded by leaf-scars. Buds are covered with valvate scales, the outer ones falling in spring, the inner ones developing into stipules.

LEAVES—Alternate, simple, ovate to oblong, thin, 4-12 inches long, pointed at apex, tapering or rounded at base, entire on margin, green and slightly downy beneath, with prominent midrib and primary veins on lower surface. Fall in response to first heavy frost in autumn.

LEAF-SCARS—Alternate, scattered along the twigs, narrow, crescent to broadly U-shaped, with its bundle-scars arranged in a U-shaped line. Bundle-scars number about 6-8.

FLOWERS—Appear from April to June. They are upright, solitary, complete, slender-bell-shaped, greenish tinged with yellow, about 3 inches long.

FRUIT—Matures about October. A red, cone-like or cucumber-like, cylindrical mass about 2-2½ inches long, composed of numerous coherent follicles. Seeds scarlet, drupe-like, and suspended at maturity by long, slender white threads.

WOOD—Diffuse-porous; rays distinct and rather uniform in width; light, soft, brittle, straight-grained, durable, does not warp when seasoning, light yellowish-brown to reddish-brown; sapwood is thin and yellowish-white. Weighs about 29 lbs. per cubic foot. Used for interior finish, furniture, pump stocks, as a substitute for Yellow Poplar, and for the same uses as White Pine. It is not so strong but more durable than the latter.

DISTINGUISHING CHARACTERISTICS—The Cucumber Tree can be distinguished by its leaves which are thin, oblong, pointed and green beneath. The leaves are larger than those of the Laurel Magnolia and smaller than those of the Umbrella Tree. The corolla is greenish tinged with yellow and the follicles of the cone-like fruit are rounded while the other two native species have white flowers and tapering follicles. It attains a much larger size and has sharper-pointed buds than the Laurel Magnolia and is considerably larger than the Umbrella Tree but has smaller and more downy buds. The bark is thicker and deeper ridged than either of the other species. The twigs are brown while those of the Laurel Magnolia are bright green.

RANGE—Western New York and southern Ontario south through West Virginia to Georgia, west to Illinois and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Found locally across the State from north to south in the mountainous region and on their eastern and western slopes. Recorded as far east as Lancaster county and as far west as Forest and Allegheny counties. Some specimens nearly 5 ft. in diameter have been recorded from the northwestern part of the State.

HABITAT—Usually found in rich woods close to streams, also inhabits slopes. In West Virginia and in this State it grows well on the soils of the carboniferous formation. It is light-demanding.

IMPORTANCE OF THE SPECIES—This species is the most important of the Magnolias native to the United States. The wood is similar to that of Yellow Poplar. In addition to producing valuable wood it grows rapidly and is rather free from the attack of destructive agents. The value of the wood alone will justify reasonable efforts in attempting to propagate it. It is also attractive ornamentally on account of its large leaves and symmetrical crown.

UMBRELLA TREE.

Magnolia tripetala, Linnaeus.

FORM—A small tree sometimes attaining the height of 45 ft. with a diameter of 16 inches. Trunk short and slender, bearing a broad round-topped crown. Lateral branches stout and spreading, often turned up towards the end.

BARK—Smooth, thick, light gray, roughened by small irregularly scattered projections.

TWIGS—Stout, smooth, shining, at first greenish, later reddish to greenish-brown; bitter, swollen at the base of each year's growth, covered with a few conspicuous lenticels; contain large, white, pink-dotted pith.

BUDS—Alternate; covered with valvate scales in pairs, each successive pair encloses a leaf; terminal and lateral buds differ much; terminal up to 2 inches in length, narrow, conical, long-pointed, often curved towards the apex, smooth or glaucous, purple, with small dots; lateral small, often barely visible, conical, divergent.

LEAVES—Alternate, simple, obovate-lanceolate, 12-24 inches long, thin-pointed at apex, tapering at base, entire on margin; smooth when old; petioles 1-1¾ inches long.

LEAF-SCARS—Alternate, often clustered at swellings along the branch, large, conspicuous, oval, somewhat raised, contain numerous irregularly scattered bundle-scars. Stipulate-scars conspicuous, encircle twig, and originate from the side of the leaf-scar.

FLOWERS—Appear about May. Upright, solitary, complete, surrounded by a spray of leaves, white, slightly and unpleasantly odorous, 4-6 inches long. Sepals fall away early.

FRUIT—Matures about October. An oblong rose-colored, cone-like mass about 2-4 inches long composed of many coherent follicles which split open and liberate red flattish seeds. The fruit is very beautiful in autumn.

WOOD—In general resembles that of the Cucumber Tree, page 157. It is not used for commercial purposes, because it is rare, small in size, light, weak, and brittle. Weighs 27.96 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Umbrella Tree, also known as Elkwood, is native only to a limited portion of the State in the Susquehanna River valley in the counties of York and Lancaster. It has larger leaf-scars, stouter twigs, larger fruit, larger and smoother buds, and larger leaves than the two other native species of Magnolia. Its leaves are crowded on the summit of the flowering branches in an umbrella-like cluster while those of the other two species are scattered along the branches. It is larger in size than the Laurel Magnolia but smaller than the Cucumber Tree.

RANGE—Southern Pennsylvania south to Georgia, west to Kentucky, Arkansas, and northern Mississippi.

DISTRIBUTION IN PENNSYLVANIA—Recorded only in the extreme southern part of the State in Lancaster and York counties along the Susquehanna River.

HABITAT—Usually found in swamps, along streams, or in ravines. It is tolerant of shade and usually occurs solitary; sometimes mixed with other hardwoods.

IMPORTANCE OF THE SPECIES—This tree is of no commercial importance in Pennsylvania on account of its limited distribution, its local and solitary occurrence, and the inferior wood which it produces. It is attractive and, hence, may be recommended for lawn and park planting, but it cannot be recommended for forestry purposes.

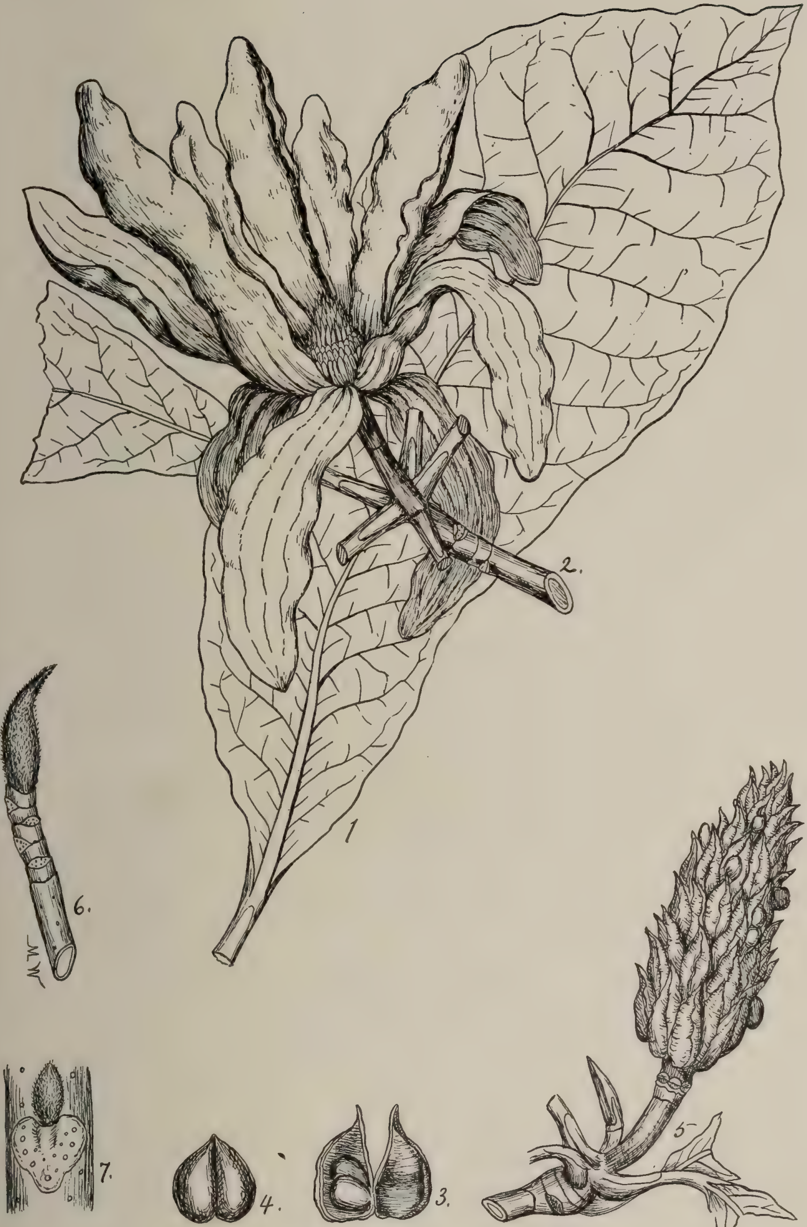

PLATE LXXVIII. UMBRELLA TREE.

1. A mature leaf, x ½.
2. Branch with a single flower and the bases of five leaves arranged in an umbrella-like circle, x ⅓.
3. A carpel split open showing seeds, natural size.
4. A seed, enlarged.
5. Branch with a terminal cone-like fruit, x ½.
6. A winter twig, x ½.
7. Section of a winter twig, enlarged.

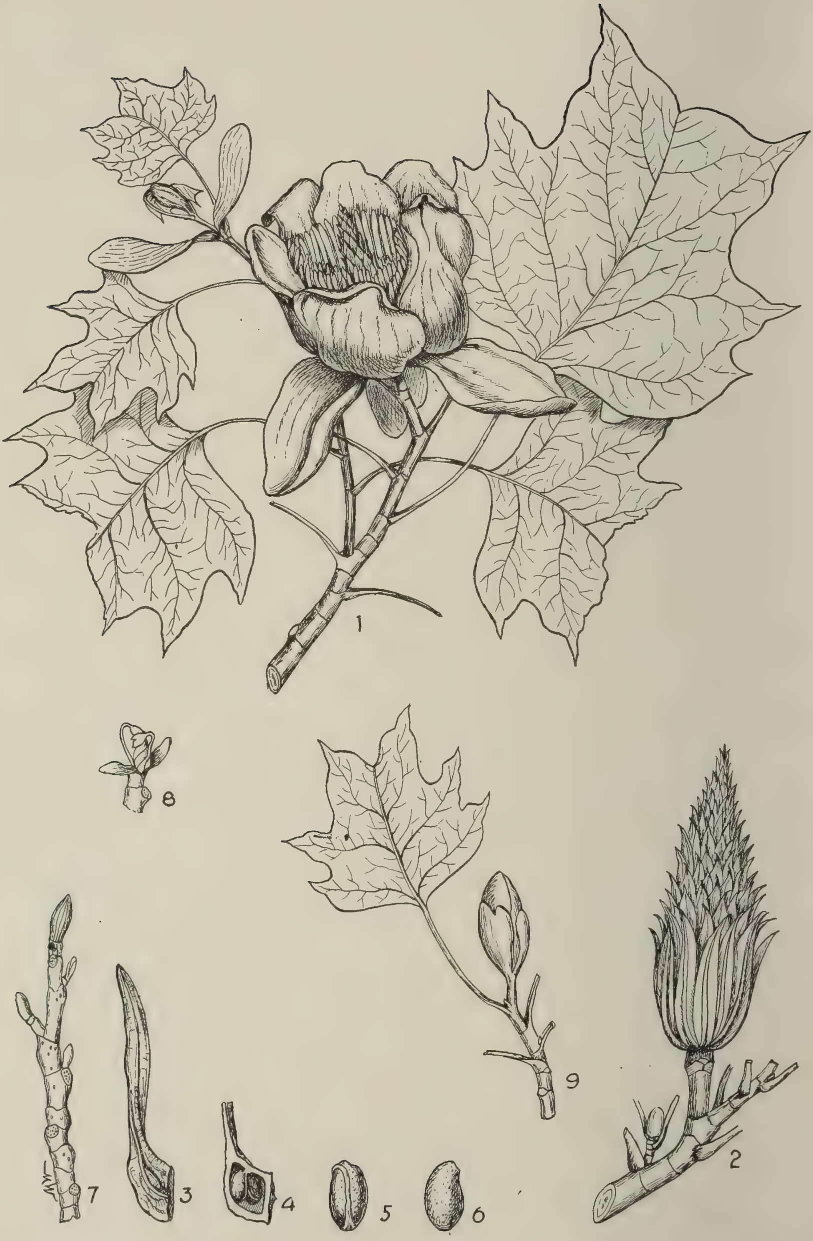

PLATE LXXIX. TULIP TREE.

1. A flowering branch with mature and developing leaves, x ½.
2. Branch with a cone-like fruit, x ½.
3. A single carpel, natural size.
4 Portion of a carpel showing seeds, natural size.
5. A seed, enlarged.
6. Side view of a seed, enlarged.
7. A winter twig, x ½.
8. A terminal bud just opening, x ½.
9. A twig showing developing leaves, x ½.

TULIP TREE.

Liriodendron Tulipifera, Linnaeus.

GENUS DESCRIPTION—This genus has numerous fossil representatives, but only one other living species, a native of China (Liriodendron chinensis, Sarg.) is known.

FORM—A large and interesting tree often attaining a height of 50-70 ft. with a diameter of 2-3 ft. and sometimes reaching a height of 200 ft. with a diameter of 10-11 feet. Prof. Guyot recorded a tree in Francis Cove, western North Carolina, known as the "Guyot or Granny Poplar," which has a diameter of 16 ft. and was free from lateral branches for more than 100 ft. from the base. Trunk tall, straight, very slightly tapering, free from lateral branches for a considerable distance from the base. Crown in young trees pyramidal, in older trees rather shallow, broad, and spreading. See Fig. 41.

BARK—When young smooth, bitter, ashy-gray. On trunks brown, thick, distinctly marked with long and regular furrows and ridges. At a distance it resembles the bark of the White Ash but lacks the characteristic diamond-shaped fissures of the latter. See Fig. 84.

TWIGS—During the first summer green, smooth, rather slender, often branching, marked with indistinct lenticels, encircled by a pair of stipules at each node. During first winter reddish-brown, smooth, shiny, marked by conspicuous pale lenticels, elevated leaf-scars and stipular rings encircling the twigs which often persist for many years.

BUDS—Alternate, large, smooth, flattened, oblong, blunt-pointed, reddish-brown mottled with white dots and covered with glaucous bloom. Lateral buds rather divergent, smaller than the terminal, sometimes superposed. Bud-scales smooth, white-dotted, spoon-shaped, valvate in pairs forming a distinct ridge where they meet. Each pair of stipular scales incloses in succession a reflexed, folded, stalked leaf with its 2 stipular scales. Stipular scales enlarge when the bud opens to a length of 2 inches and width of 1 inch. Each succeeding leaf is reflexed in the opposite direction of the preceding one.

LEAVES—Alternate, simple, broadly ovate in outline, truncate at apex, with 2 apical and 2-4 basal lobes, bright green above, paler below. Petioles slender, 5-6 inches long.

LEAF-SCARS—Alternate, elevated, conspicuous, large, orbicular. Bundle-scars small, numerous, scattered uniformly over the leaf-scar.

FLOWERS—Appear after the leaves; large, 1½-2 inches deep, cup-shaped, greenish-yellow, with 3 reflexed sepals and 6 converging petals.

FRUIT—Matures in September or October; a light brown, oblong, pointed cone 2½-3 inches long, ½ of an inch wide, consisting of carpels 1-1½ inches long in the base of which the seeds are contained.

WOOD—Diffuse-porous; with small inconspicuous medullary rays; soft, not strong, light, not durable in ground, easily worked, light yellowish or brownish heartwood with thin white sapwood. Weighs 26.36 lbs. per cubic foot. Used in construction, interior finish, furniture especially in veneering, shingles, wooden-ware and automobile bodies. Its uses are somewhat similar to White Pine.

DISTINGUISHING CHARACTERISTICS—The Tulip Tree also known as Yellow Poplar, White-wood, Tulip Poplar and sometimes Popple, can readily be recognized in summer by its straight clean fissured bole, its characteristic leaves with truncate apex and large stipules. The leaf cannot be confused with that of any other species since it appears from a distance to have its apex cut off at right angles to the midrib. In spring the flower is also distinctive. In winter the large clean trunks with their peculiar fissures in the bark together with the fruit which often persists, are characteristic. At close range the buds with the stipule-scars encircling the twigs will always enable one to recognize this species without fail. The rather large pith often divided by partitions of stone cells is peculiar.

RANGE—Botanical range from Rhode Island to Michigan and Missouri, south to Florida and Arkansas. Commercial range not so wide.

DISTRIBUTION IN PENNSYLVANIA—Most common along streams or moist locations in the eastern and southern parts of the State. Also found locally in western part. It does not appear in pure stands, but some excellent stands almost approaching pure stands are found in Franklin, Adams, and Northampton counties.

HABITAT—It prefers deep, rather rich, and moist soil. Common along streams, on islands, upon semi-swampy areas, and at the base of mountain slopes. Sometimes found on the tops of mountains especially where small streams and springs are prevalent. Usually occurs as scattered individuals mixed with other hardwoods and sometimes White Pine and Hemlock.

IMPORTANCE OF THE SPECIES—The Tulip Tree is one of the most valuable and desirable timber trees of Pennsylvania. Its wood belongs in the first rank with White Pine. It is rather difficult to propagate artifically on account of the low fertility of the seeds and its sensitiveness to transplanting. Attempts have been made to propagate it by means of cuttings but without success. Natural seed regeneration of this species can be carried on with success and should be advocated and developed in preference to the artificial. This species is also free from insect and fungal diseases and most desirable as a shade, lawn, and avenue tree.

COMMON PAPAW.

Asimina triloba, Dunal.

FAMILY AND GENUS DESCRIPTION—The Custard Apple family, Anonaceae, comprises about 46 genera with 600 species confined mostly to the tropics. Only a few species are found in temperate regions. This family produces little that is of real economic importance. Only 2 genera, Asimina and Anona, are represented by tree species in the United States. The genus Asimina does not have representatives outside of North America, where about 8 species are known to occur. The sole representative of this family native to this State is the species described on this page.

FORM—A small tree usually 10-40 ft. in height with a diameter up to 12 inches. Trunk short and slender. Crown rather broad, high, and formed by straight rather spreading lateral branches.

BARK—Thin, close, sometimes slightly fissured, dark brown, often covered with scattered white blotches.

TWIGS—Round, olive-brown, enlarged at the nodes, rather slender, at first often somewhat hairy towards apex; later smooth, covered with a few fine lenticels which become evident during second year; pith small and white.

BUDS—Alternate, 2-ranked or sometimes 3-ranked, brown, naked, hairy. Terminal, lateral leaf and flower buds differ in size and form. Terminal bud is much longer than the others and evidently flattened. Lateral leaf-buds about ⅛ of an inch long, closely appressed to twig and located in notch on upper surface of leaf-scars. Flower-buds are lateral along the twig, spherical in outline, about 1/6 of an inch in diameter, very hairy and dark brown; do not stand quite parallel to twig.

LEAVES—Alternate, simple, obovate-lanceolate, 4-12 inches long, thin, pointed at apex, tapering at base, entire on margin, when mature dark green above and paler below. In autumn they turn rusty yellow.

LEAF-SCARS—Alternate, located on enlarged projections of the twig, inclined at about an angle of 35 degrees to the twig, broadly U-shaped, almost surround bud, somewhat lighter than the twig, contain usually 5 bundle-scars which are often compounded. A ridge extends across the leaf-scar from the bud to the base of the scar.

FLOWERS—Appear about April or May with the leaves but are usually located below them along the twigs. They occur solitary and axillary; are perfect, at first green, later reddish-purple, 1-1½ inches wide, and borne on stout hairy stalks.

FRUIT—Suggests a stubby banana, is cylindrical, rounded, or occasionally blunt-pointed at the ends, 3-5 inches long, at first green, later dark-brown, pulpy, edible, contains many dark-brown, shiny, flattened seeds which are scattered throughout the flesh.

WOOD—Ring-porous with a diffuse-porous tendency; rays very numerous and distinct; heartwood brownish; sapwood yellowish; weak, soft, weighs about 25 lbs. per cubic foot. Not used commercially.

DISTINGUISHING CHARACTERISTICS—The Common Papaw can be recognized best in autumn by its unique fruit which is very suggestive of a stubby banana. In spring the greenish-brown to reddish-purple flowers which occur solitary along the twigs and measure 1-1½ inches across are also characteristic. The large, tropical-like, alternate leaves will also aid in recognizing it. In winter the long, slender, somewhat flattened, naked, brownish, terminal buds and the spherical flower-buds along the side of the twigs and the U-shaped leaf-scars which almost surround the buds and usually contains 5 bundle-scars, will enable one to distinguish it The fact that it occurs only in about the southern third of the State may also help in distinguishing it.

RANGE—Western New York and west central New Jersey south to Florida and west to Michigan, Kansas, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Locally found in small groups in practically every county of the State south of a line drawn from Pittsburgh through Harrisburg and Reading to Doylestown in Bucks county. Not common anywhere but well known on account of its peculiar fruit. Usually found below altitude of 1,000 feet but in the South Mountains in Adams and Franklin counties found at 1,200 feet.

HABITAT—Prefers rich moist situations. Usually found in river valleys near streams but occasionally ascends low fertile slopes. It may form dense thickets but in this State usually occurs solitary or in rather open groups. Occurs with other species in the understory of the forest, and is very tolerant of shade.

IMPORTANCE OF THE SPECIES—This species is of no commercial importance as a forest tree anywhere in its range. The fruit which it produces is of more value than its wood. I never reaches a large size, and in addition is local and limited in its distribution. It is, however, a very attractive tree on account of its somewhat drooping tropical leaves, handsome flowers, and peculiar fruit.

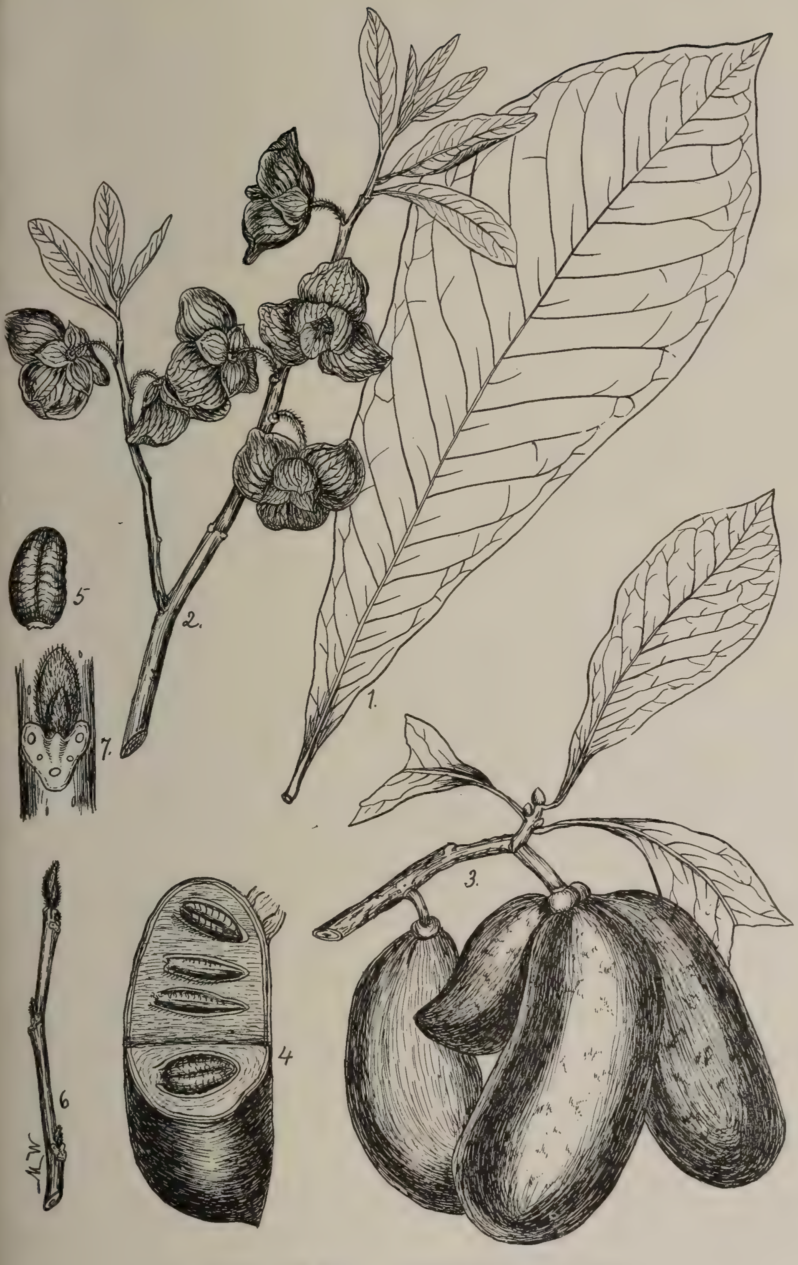

PLATE LXXX. COMMON PAPAW.

1. A mature leaf, x ½.
2. A flowering branch with immature leaves, x ½.
3. A fruiting branch, x ½.
4. Section of a fruit showing seeds, x ½.
5. A seed, natural size.
6. A winter twig, x ½.
7. Section of a winter twig, enlarged.

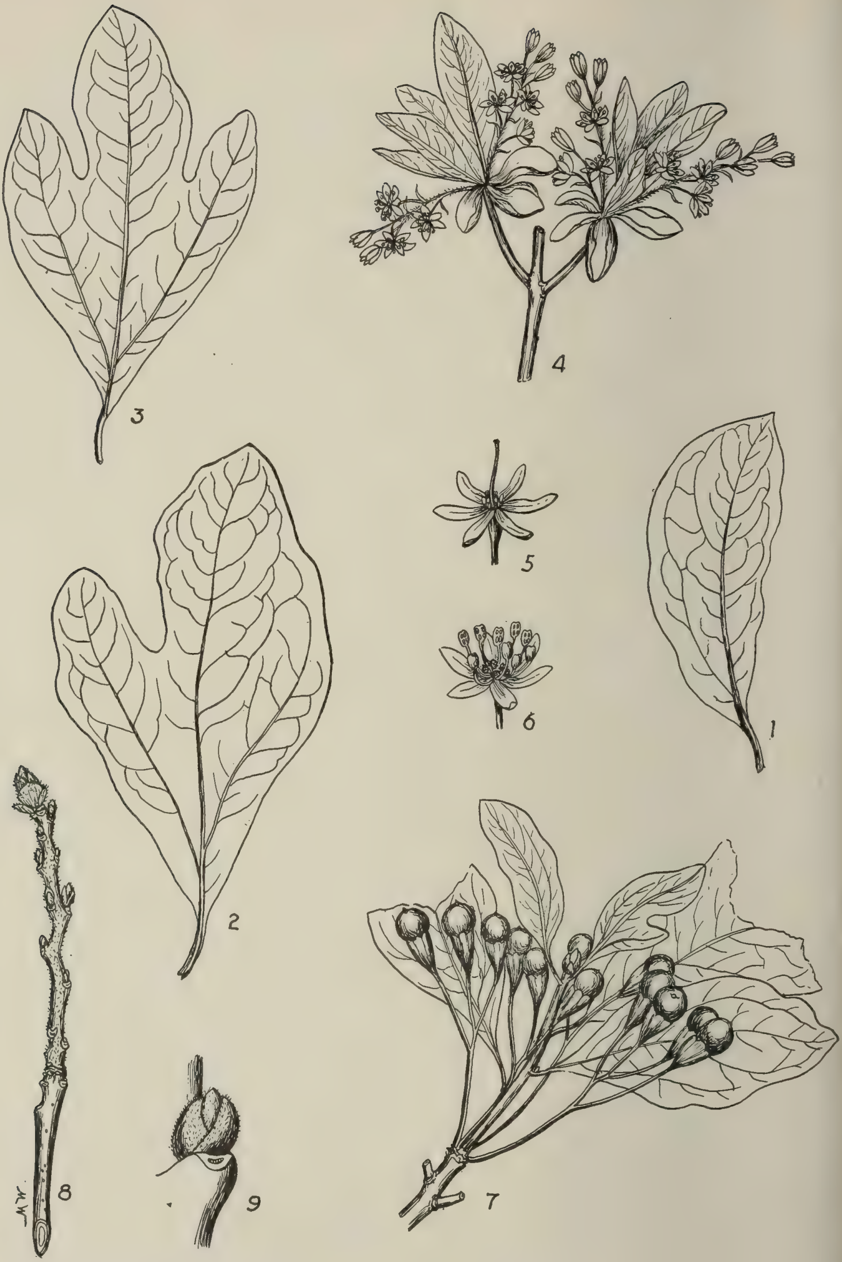

PLATE LXXXI. SASSAFRAS.

1. An ovate, entire leaf, x ½.
2. A glove-form leaf, x ½.
3. A 3-lobed leaf, x ½.
4. A flowering branch with immature leaves, x ½.
5. A fertile flower, enlarged.
6. A sterile flower, enlarged.
7. A fruiting branch, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, x ½.

SASSAFRAS.

Sassafras variifolium, (Salisbury) Kuntze.

FAMILY AND GENUS DESCRIPTION—The Laurel family, Lauraceae, comprises about 40 genera with between 900 and 1,000 species which are confined mostly to the tropics. Six genera are found in North America, 4 of which reach tree-size. Two genera, Sassafras and Benzoin, are native to Pennsylvania. The species described on this page is the sole representative in North America of the genus Sassafras, but another species is recorded from China. The sole representatives in this State of the genus Benzoin is the Spice Bush (Benzoin aestivale (L.) Nees.) The Spice Bush can readily be distinguished by its small size, its aromatic and spicy twigs, its simple, entire, alternate leaves, its clusters of yellow flowers which appear before the leaves, and its scarlet fruit.

FORM—Usually reaches a height of 40-50 ft. with a diameter of 1-3 ft., but in the South may reach a height of 100 ft. with a diameter of 2-4 feet. Trunk usually stout, short, bearing a crown with more or less contorted branches. Crown usually flat-topped or rounded, the terminal part rather dense, the lower part very open. Branches are extremely brittle. See Fig. 40.

BARK—Roughened with shallow fissures frequently as early as the third year, hence a young tree often appears old. On older trunks reddish-brown, deeply fissured, and flat ridged. Ridges resemble small blocks, or Ys, or Vs, and separate into thin appressed scales. Shallow, horizontal, and ring-like fissures sometimes almost encircle trunk. See Fig. 67.

TWIGS—Usually slender except in sprouts, rather brittle, yellowish-green or sometimes reddish, somewhat hairy, often smooth and glossy, aromatic, brittle, fall off young, covered with few lenticels, contain large white pith. Inner bark of twigs is very mucilaginous upon being chewed. Sprouts branch freely and seedlings more sparingly.

BUDS—Alternate; terminal bud present, large 1/3-3/5 of an inch long, ovate, sharp-pointed, covered with a few rather loose-fitting, slightly hairy green bud-scales with thickened veins. A few, usually 3, rather thick, loose, short, narrow scales surround terminal bud. Lateral buds are smaller, gaping, and somewhat divergent.

LEAVES—Alternate, simple, ovate, 4-6 inches long, acute at apex, wedge-shaped at base, entire or 2-5-lobed, usually smooth and dark green above and paler below. Entire, 2-lobed, 3-lobed, and 5-lobed ones may be found on same branch.

LEAF-SCARS—Alternate, small, raised, semi-elliptical or concave, with a single, confluent, linear bundle-scar.

FLOWERS—Appear about May with the leaves. Staminate and pistillate flowers are separate. They are greenish-yellow and arranged in loose drooping racemes.

FRUIT—A dark blue, shiny drupe borne on a bright red, club-shaped, fleshy stem terminated by an enlarged calyx in which the drupe rests. Falls rather early, rarely persistent.

WOOD—Ring-porous; with indistinct medullary rays; soft, very brittle, durable in contact with soil, aromatic, dull-orange brown, with thin light sapwood. Weighs 31.42 lbs. per cubic foot. Used for posts, rails, furniture, interior finishings. Often sold as Ash and Chestnut.

DISTINGUISHING CHARACTERISTICS—The Sassafras, also known as Saxifrax, and Sassafrac, can be distinguished at any time of the year by its very smooth glossy bark of the twigs which is decidedly mucilaginous and aromatic. The leaves which may be entire, or 2-5-lobed and the single bundle-scar in the leaf-scars are also characteristic. The fruit, the rough and distinctively fissured bark, and the brittle lateral branches are peculiar to this species. Once recognized it is hard to confuse it with another species.

RANGE—Massachusetts to Florida and west to Michigan, Kansas, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Rather common in the eastern, southern, and western parts of the State. Rarer in the central and northern or mountainous parts.

HABITAT—Very common along fence rows, in abandoned fields, and on abandoned charcoal hearths. Prefers rich sandy loam. Rather tolerant of shade and water.

IMPORTANCE OF THE SPECIES—The Sassafras is of little commercial importance in this State on account of its limited distribution and the small size which it reaches. It is a rather picturesque tree, especially in winter. The fruit furnishes a valuable food for birds while the wood, bark, and especially the roots, yield an aromatic oil extensively used to flavor medicine and candy, and to perfume soaps.

WITCH-HAZEL.

Hamamelis virginiana, Linnaeus.

FAMILY AND GENUS DESCRIPTION—The Witch-hazel family, Hamamelidaceae, contains about 16 genera with 50 species of which number only 2 genera have tree representatives in North America. The 2 genera are Hamamelis and Liquidambar. Each genus is represented by a single species, both native to Pennsylvania. The genus Hamamelis comprises 3 species, 2 of which are found in eastern Asia and 1 described here.

FORM—A small tree or shrub sometimes reaching a height of 25 ft. with a diameter of 14 inches, but usually smaller. Trunk short, bears numerous spreading, crooked branches which form a broad open head.

BARK—About 1/5 of an inch thick, light brown, somewhat mottled with light blotches; when young smooth, later scaly. Inner bark reddish-purple in color. Used for medicine, extract, and gargles.

TWIGS—Zigzag, light brown, with small light green pith, rather slender, often downy or scurfy especially near the end, sometimes smooth and shiny, covered with a few, scattered, white lenticels.

BUDS—Alternate, 2-ranked, flattish, sometimes curved or falcate, covered with scale-like undeveloped leaves bearing dense brown hairs. Terminal buds usually sickle-shaped, about ¼-½ of an inch long. Lateral buds few and very small.

LEAVES—Alternate, simple, oval, 4-6 inches long, rounded or sometimes acute at apex, oblique at base, dentate on margin, dark green above, paler beneath; midrib and primary veins prominent.

LEAF-SCARS—Alternate, 2-ranked, semi-circular in outline with a raised margin, and contain 3 single or often compound bundle-scars which are lighter in color than the dark brown surface of the leaf-scar.

FLOWERS—Appear in October and November. Bright yellow, perfect, occur in small axillary clusters, surrounded by a scale-like 3-leaved involucre. Buds which produce the flowers occur in clusters of 3 on short stalks, are spherical in form, and start to develop about August in the axils of the leaves.

FRUIT—Ripens in October and November at the same time that the blossoms appear. It results from blossoms of the previous year, consists of a yellowish-brown woody pod with two cells in which shiny black seeds are produced. The woody pods burst open when ripe, and propel the seed for 5 or more feet.

WOOD—Diffuse-porous; rays not very distinct; little difference between spring and summer wood; hard, close-grained, light brown. Weighs 42.5 lbs. per cubic foot. Not used commercially.

DISTINGUISHING CHARACTERISTICS—The Witch-hazel can be distinguished in winter by its sickle-shaped, brown, terminal buds, its yellowish-brown fruit in the form of a woody pod with two cells, its persistent remnants of the flowers on stalks and its white blotched or mottled light brown bark. In late autumn the flowers with strap-like yellow petals are characteristic. The alternate oval leaves with straight veins and oblique bases are also distinctive. It usually frequents moist rocky locations.

RANGE—Nova Scotia and Ontario, south to Florida, and west to Minnesota and Texas.

DISTRIBUTION IN PENNSYLVANIA—No doubt found in every county of the State. Reported and observed in more than one-half of the counties, located in every part of the State. This is the most common and widely distributed small tree or shrub in Pennsylvania.

HABITAT—Usually found in moist rocky situations. Common along streams, in swamps, and on the borders of ponds and lakes. Occasionally ascends slopes to rather dry locations. Tolerant of shade, hence often found in the understory of the forest.

IMPORTANCE OF THE SPECIES—This species is of no commercial importance because it remains too small and produces inferior wood. No records are available which show that a single board foot has ever been on the market. It is, however, a very interesting small tree because it holds a unique position in that it blossoms late in autumn when many other trees have shed their leaves and are prepared for winter. It may be protected in situations where it does not interfere with the growth or utilization of more valuable species. No special efforts are necessary to insure an abundant future supply.

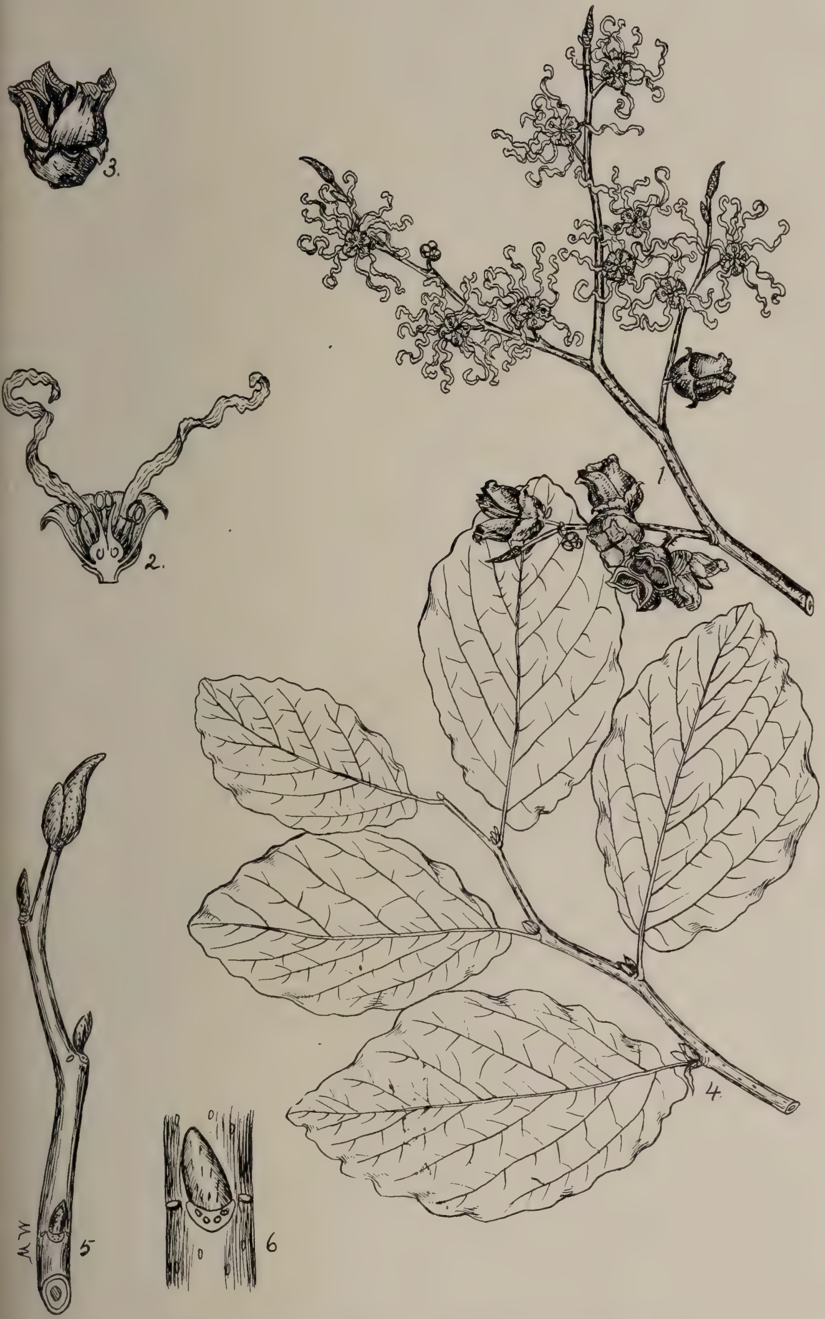

PLATE LXXXII. WITCH-HAZEL.

1. A flowering and fruiting branch, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruit, natural size.
4. A branch with mature leaves, x ½.
5. A winter twig, natural size.
6. Section of a winter branch, enlarged.

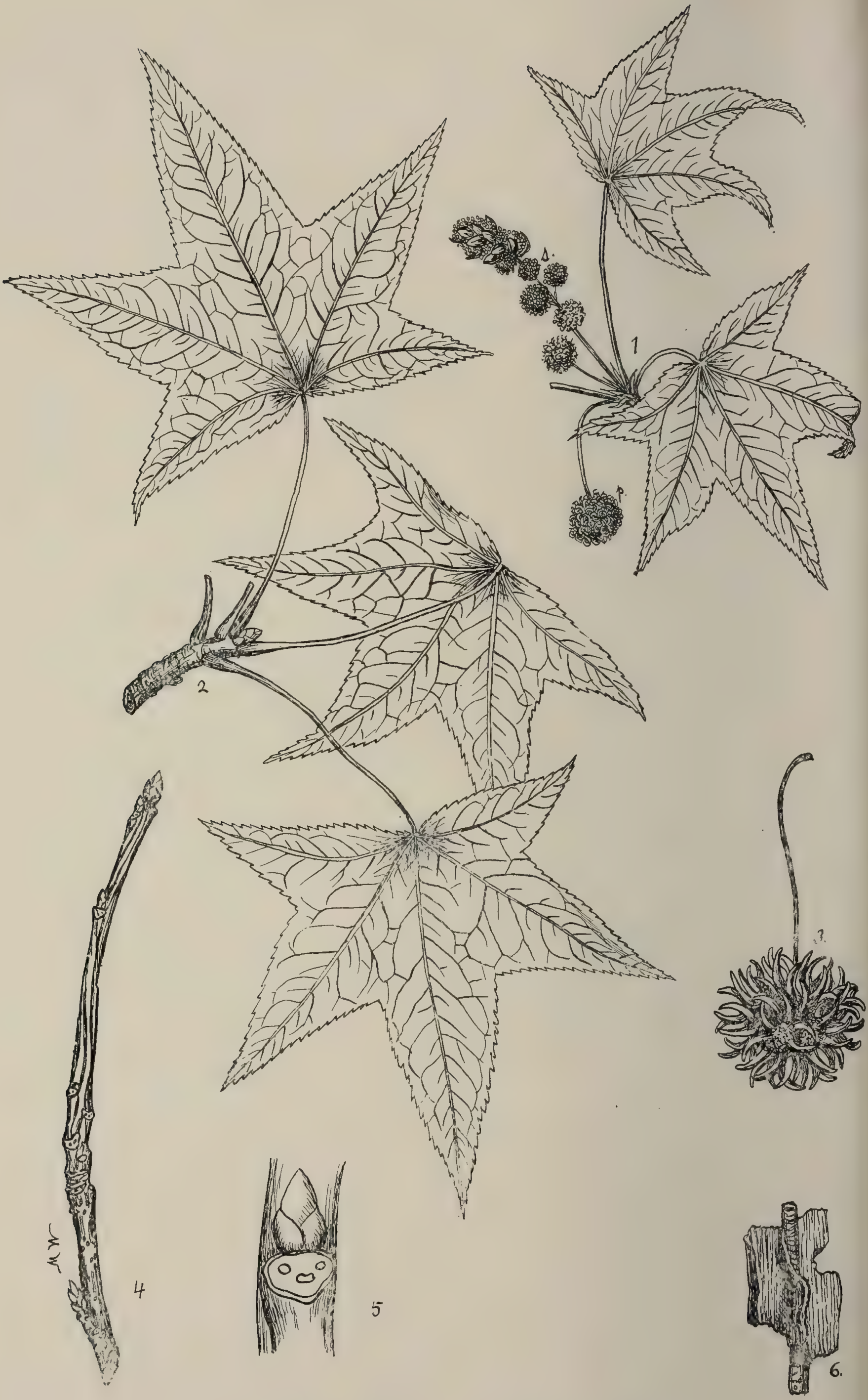

PLATE LXXXIII. SWEET GUM.

1. A flowering branch showing immature leaves, (s) staminate flowers, (p) pistillate flowers, x ½.
2. A branch with mature leaves, x ½.
3. A spherical fruit, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.
6. Section of a branch with corky projections, x ½.

SWEET GUM.

Liquidambar Stryaciflua, Linnaeus.

GENUS DESCRIPTION—This genus comprises 3 species, 2 of which are found in Asia and 1 in North America. The latter is native to a small portion of southeastern Pennsylvania. A few fossil forms are also known. The generic name, Liquidambar, is a mongrel, the fore part of which is of Latin origin and means liquid and the latter part of Arabic origin and means amber in allusion to the fragrant juice of the tree.

FORM—A large forest tree usually from 50-75 ft. high with a diameter of 2-3 ft., but may reach a height of 150 ft. with a diameter of 4-5 feet. In the forest the trunk is tall, clean, slightly tapering, and bears a narrow head. In open grown trees the trunk is short, bearing rather regular spreading branches which form a symmetrical and rather conical crown.

BARK—On old trunks grayish-brown, 1-1½ inches thick, deeply furrowed separating broad scaly ridges. On younger trunks thinner and dark gray.

TWIGS—Rather stout, obscurely angular, at first rusty hairy, later smooth, light brown to dark reddish-brown, roughened by raised leaf-scars and scattered, dark, raised lenticels and after the second season often by corky-winged projections of the bark. Pith rather large, angular, and very light brown.

BUDS—Alternate, more than 2-ranked, ovate to conical, blunt-pointed to sharp-pointed, glossy, rich reddish-brown, fragrant when crushed, covered with about 6 visible ovate scales which have a short-pointed apex, downy margin, and a rounded back. Lateral buds are sometimes accessory.

LEAVES—Alternate, simple, star-shaped, 3-5 inches long, broader than long; base at right angles to stalk or slightly heart-shaped; margin serrate, with 5-7 sharp-pointed divisions; when mature bright green and shiny above, paler below. Leaf-stalks long and round.

LEAF-SCARS—Alternate, more than 2-ranked, raised, slightly inclined to twig, crescent-shaped or broadly heart-shaped, with a dark surface, containing 3 circular bundle-scars which are white on the periphery and dark in the center.

FLOWERS—Appear about April when leaves are partly developed. Staminate flowers green, borne in terminal racemes, 2-3 inches long, covered with rusty hairs. Pistillate flowers green, occur in heads borne on long stalks originating in the axils of leaves.

FRUIT—A long-stalked spherical head made up of many capsules which have a spiny appearance, about 1-1½ inches in diameter, persists far into winter. Individual capsules often filled with sawdust-like material which consists of abortive seeds.

WOOD—Diffuse-porous; rays distinct; rather heavy, hard, with interlocked grain, somewhat difficult to work, reddish-brown with dark streaks, sapwood wide and white. Weighs 36.83 lbs. per cubic foot. Used for boxes, crates, furniture, interior finish, and extensively as a substitute for Circassian Walnut.

DISTINGUISHING CHARACTERISTICS—The Sweet Gum, also known as Bilsted, Red Gum, and Liquidambar, can be recognized by its fruit which is in the form of a spine-like head suspended on a long slender stalk. The fruit often persists far into winter. The corky-winged projections on the bark of the branchlets are also characteristic. The Bur Oak, a native species, and the Cork Elm, an introduced species, also have this characteristic. The star-shaped leaves, reddish-brown twigs, and leaf-scars with their bundle-scars are distinctive. It is native only to the extreme southeastern part of the State, but rather commonly planted in other parts.

RANGE—Southern Connecticut south to Florida and west to Ohio, Missouri, and Texas, and southward to Guatemala.

DISTRIBUTION IN PENNSYLVANIA—Found only in the extreme southeastern part of the State. Reported from Bucks, Philadelphia, and Delaware counties.

HABITAT—It prefers deep rich soil such as will produce White Oak, Hickory, and Yellow Poplar. Does not tolerate shade, hence almost invariably found in the open or in even-aged stands. On account of its intolerance one seldom finds it as regeneration on the forest floor.

IMPORTANCE OF THE SPECIES—This species attains a large size and produces fairly valuable wood but it usually requires soil adapted to agriculture or which will grow more valuable trees such as White Oak, White Ash, Hickory, and Yellow Poplar. It hardly pays to propagate this species artificially in this State and it is too limited in its distribution to regenerate it by natural means. It is a very attractive ornamental tree.

THE ROSE FAMILY—ROSACEAE.

This is one of the largest families of plants. It comprises about 100 genera with about 1,500 species, many representatives of which are native to North America. The flora of Pennsylvania comprises about 30 genera with more than 100 species.

The members of this family comprise trees, shrubs, and herbs. They have a world-wide distribution. A few of the trees are important on account of the timber which they produce while many are important on account of the valuable fruit which they yield. Most of our common and well-known fruit trees belong to this family. Many of its shrubs are common and most attractive.

The leaves of the representatives of this family are simple or compound and always alternate, never opposite. The flowers are perfect, showy, and open in spring or early summer. Many species have very fragrant and attractive flowers. The fruit matures in one season and is variable in form and structure. It may be in the form of achenes, follicles, pomes, or drupes. Some species like the Cherries, Plums, and Peaches have fruits which are edible and well known. Their pulp is usually juicy, sweet or bitter, sometimes astringent, and covers a hard-shelled round or flat seed. On account of the palatable nature of most of the fruits they are readily eaten by man, birds, and wild animals. The seeds are not injured by passing through the alimentary canal of animals and hence may be thus widely dispersed. The wood in many species is valuable but in our flora all but one species remain too small to be of any commercial value.

Of the large number of genera and species found in Pennsylvania only 9 species belonging to 4 different genera are described below. In addition to these a few other genera have well-known representatives. The Ninebark (Physocarpus opulifolius, (L.) Maxim.), is a common shrub throughout the State along rocky banks of streams. It is the only representative of its genus in Pennsylvania. The Strawberries belonging to the genus Fragaria have a few common representatives. The Raspberries, Blackberries, and Dewberries, belonging to the genus Rubus, have about 20 species native to this State. The Wild Roses, belonging to the genus Rosa, have at least 7 species native to the State. In addition to these there are many herbaceous species.

KEY TO THE GENERA.

			Page.
1.	Unbranched thorns present on twigs, situate at the nodes,	**Crataegus**	170
1.	Thorns not present on twigs,	2	
2.	Fruit a drupe; pistil one; twig with characteristic taste and odor, usually covered with horizontally-elongated lenticels,	**Prunus**	165
2.	Fruit a pome; pistils more than one usually 3-5; twigs with a different characteristic taste, without horizontally-elongated lenticels,	3	
3.	Cavities of the ovary same number as the styles; buds not narrow-conical and not greenish-yellow,	**Pyrus**	172
3.	Cavities of the ovary becoming twice the number of the styles; buds narrow-conical and greenish-yellow,	**Amelanchier**	174

THE PLUMS AND CHERRIES—PRUNUS, (Tourn.) Linnaeus.

This genus comprises about 90 species well distributed over the north temperate zone and locally in the tropics. A large number of the representatives are found in North America. Seven species are native to Pennsylvania and 4 foreign species have been extensively naturalized. Only 4 of the native species are described on the following pages. The other native species are Porter's Plum (Prunus alleghaniensis), Appalachian Cherry (Prunus cuneata), and the Sand Cherry (Prunus pumila).

Among the introduced species which have been cultivated extensively are the Domestic or Sweet Cherry (Prunus avium), the Sour Cherry (Prunus Cerasus), the Perfumed Cherry (Prunus Mahaleb), and the Peach (Prunus Persica). The latter was introduced from Asia and the others from Europe.

SUMMER KEY TO THE SPECIES.

Page.

1. Flowers in racemes terminating leafy branches, hence appearing after the leaves,....2
1. Flowers in umbels developing from lateral buds before or with the leaves, ...3

2. Leaves thickish, oblong or oblong-lanceolate, taper-pointed, serrate with short incurved stout teeth; inner bark aromatic, ...P. serotina 166
2. Leaves rather thin, oval to obovate, short-pointed, very sharply serrate with somewhat spreading slender teeth; inner bark with a rank disagreeble odor, P. virginiana 167

3. Flowers small; fruit small, borne in clusters; branches not thorny or armed,........ P. pennsylvanica 168
3. Flowers large; fruit large borne singly; branches often thorny or armed, P. americana 169

WINTER KEY TO THE SPECIES.

1. Terminal buds absent, ...P. americana 169
1. Terminal buds present, ...2

2. Buds clustered at the tips of the twigs; twigs rather slender usually less than 1/16 of an inch in thickness, ...P. pennsylvanica 168
2. Buds rarely clustered and if clustered only on stubby lateral spurs; twigs relatively stout, usually over 1/16 of an inch in thickness, ...3

3. Medium to large tree; bark on old trunks black and rough; buds relatively small with uniformly-colored scales sharp-pointed at apex, ...P. serotina 166
3. Small tree to shrub; bark on old trunks brown and rather smooth; buds relatively large with grayish-margined scales rounded at the apex, ...P. virginiana 167

WILD BLACK CHERRY.

Prunus serotina, Ehrhart.

FORM—Usually reaches a height of 50-75 ft. with a diameter of 2-3 ft., but may attain a height of 110 ft. with a diameter of 5 feet. In forest grown specimens the trunk is usually long, clean, and with little taper, while in open grown specimens it is usually short. Crown rather irregularly-oblong.

BARK—On young trunks (Fig. 96) rather smooth, glossy, reddish-brown, marked with conspicuous white horizontally-elongated lenticels; peels off in thin film-like layers, and exposes greenish inner bark. On old trunks (Fig. 97) blackish, roughened by thick irregular plates with projecting edges.

TWIGS—Smooth, rather slender, reddish-brown, marked with numerous, pale, round lenticels which in time become horizontally-elongated; pith white or light brown. Often covered with a thin, film-like, grayish coating which rubs off readily. Inner bark has a characteristic bitter taste and a rather pleasant odor.

BUDS—Alternate, about 1/8-1/6 of an inch long, ovate, usually sharp-pointed, smooth, glossy, reddish-brown, covered by about 4 visible ovate bud-scales which are sometimes coated with a smoky or grayish film-like skin. Lateral buds usually divergent but sometimes appressed, flattened, and larger than the terminal.

LEAVES—Alternate, simple, oblong or lanceolate-oblong, 2-5 inches long, tapering or rounded at base, taper-pointed at apex, serrate on margin with short incurved teeth, rather thick and shiny above, paler beneath.

LEAF-SCARS—Alternate, more than 2-ranked, raised on projections of the twig, semi-elliptical tendency in outline, with 3 bundle-scars.

FLOWERS—Appear in May or June; white, perfect, about ¼ of an inch across, borne in elongated drooping racemes 3-4 inches long.

FRUIT—A purplish-black juicy drupe, ⅓-½ of an inch in diameter, arranged in rather open drooping clusters; seed stony. Matures in summer.

WOOD—Diffuse-porous; rays very distinct; heartwood reddish-brown; sapwood narrow and yellowish; moderately heavy, hard and strong, fine-grained, does not warp or split in seasoning. Young wood is very durable. Its value is due to color and lustre and not to figure. Weighs 36.28 lbs. per cubic foot. Used principally in furniture and finish; also used for tools like spirit levels, implements, patterns, cores, and for high class panels.

DISTINGUISHING CHARACTERISTICS—The Wild Black Cherry, also known as Wild Cherry, Rum Cherry, Black Cherry, and Cabinet Cherry, may be distinguished from our other native species by its larger size and by the rough, dark, scaly bark which is found on the older trunks. For further distinguishing characteristics see Choke Cherry, page 167, and Fire Cherry, page 168. The introduced Domestic Cherry (Prunus avium) can be distinguished from this one by its stouter often grayish twigs, its smoother and shiny bark (Fig. 98) with conspicuous long and high lenticels and its clustered buds at the tips of stubby, lateral, spur-like branches. The fruit of the Domestic Cherry is larger than that of our native cherries and the leaves have rounded teeth often with glands and are frequently slightly pubescent on the lower side.

RANGE—Nova Scotia south to Florida, westward to South Dakota, Kansas, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. Rather common but nowhere very abundant. Usually occurs solitary in mixture with other species.

HABITAT—Thrives best on rich alluvial soil and fertile slopes. It will grow on dry and often rather sterile slopes. On account of its long tap-root it requires loose deep soil.

IMPORTANCE OF THE SPECIES—This is a very important timber tree. Its wood is valuable especially for furniture and interior finish. Nowhere in its range has it ever been very abundant and on account of its prized wood it has been cut extensively. As a consequence it is now becoming rare, in fact marching towards extinction. It deserves to be planted extensively and to be protected carefully where it is found growing naturally.

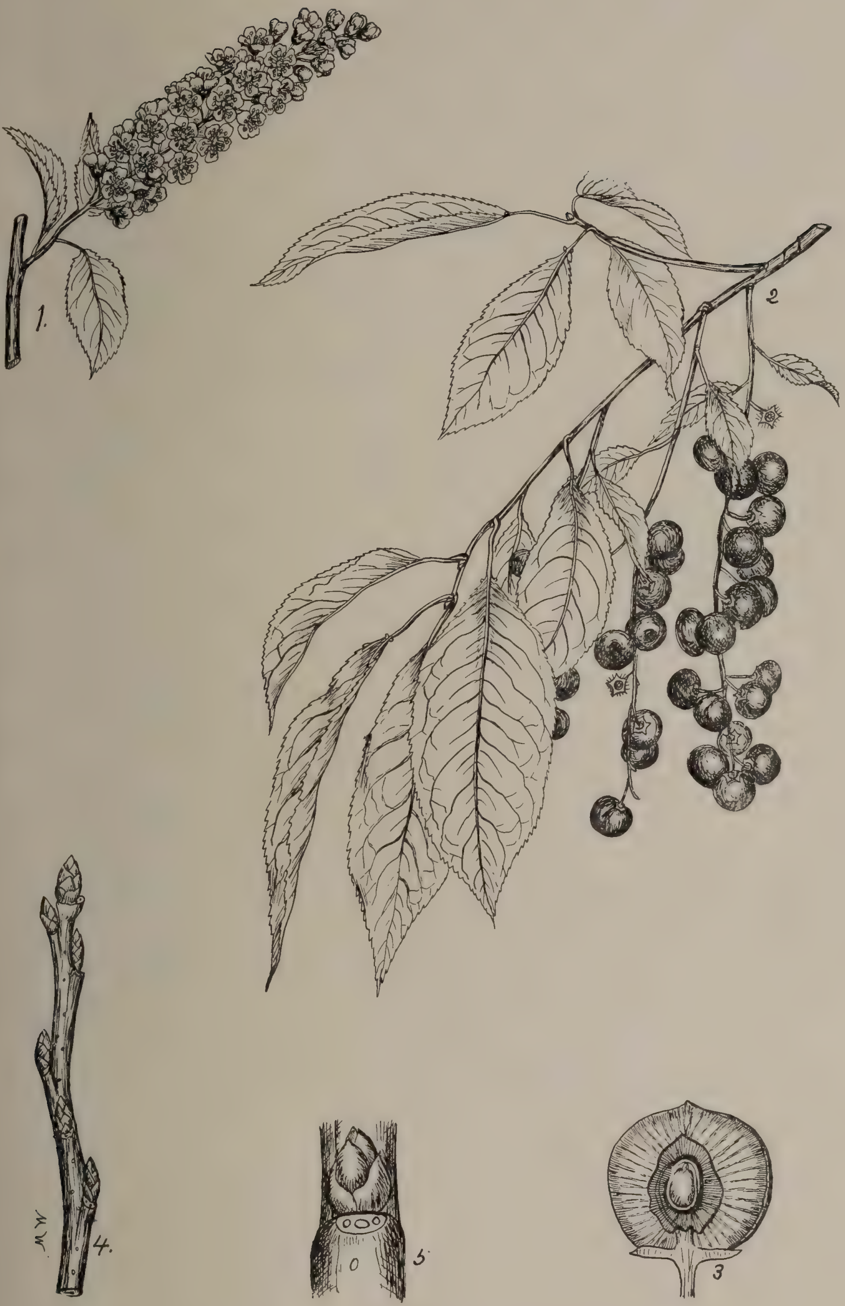

PLATE LXXXIV. WILD BLACK CHERRY.

1. Section of a flowering branch, x ½.
2. A fruiting branch, x ½.
3. Section of a fruit, enlarged.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

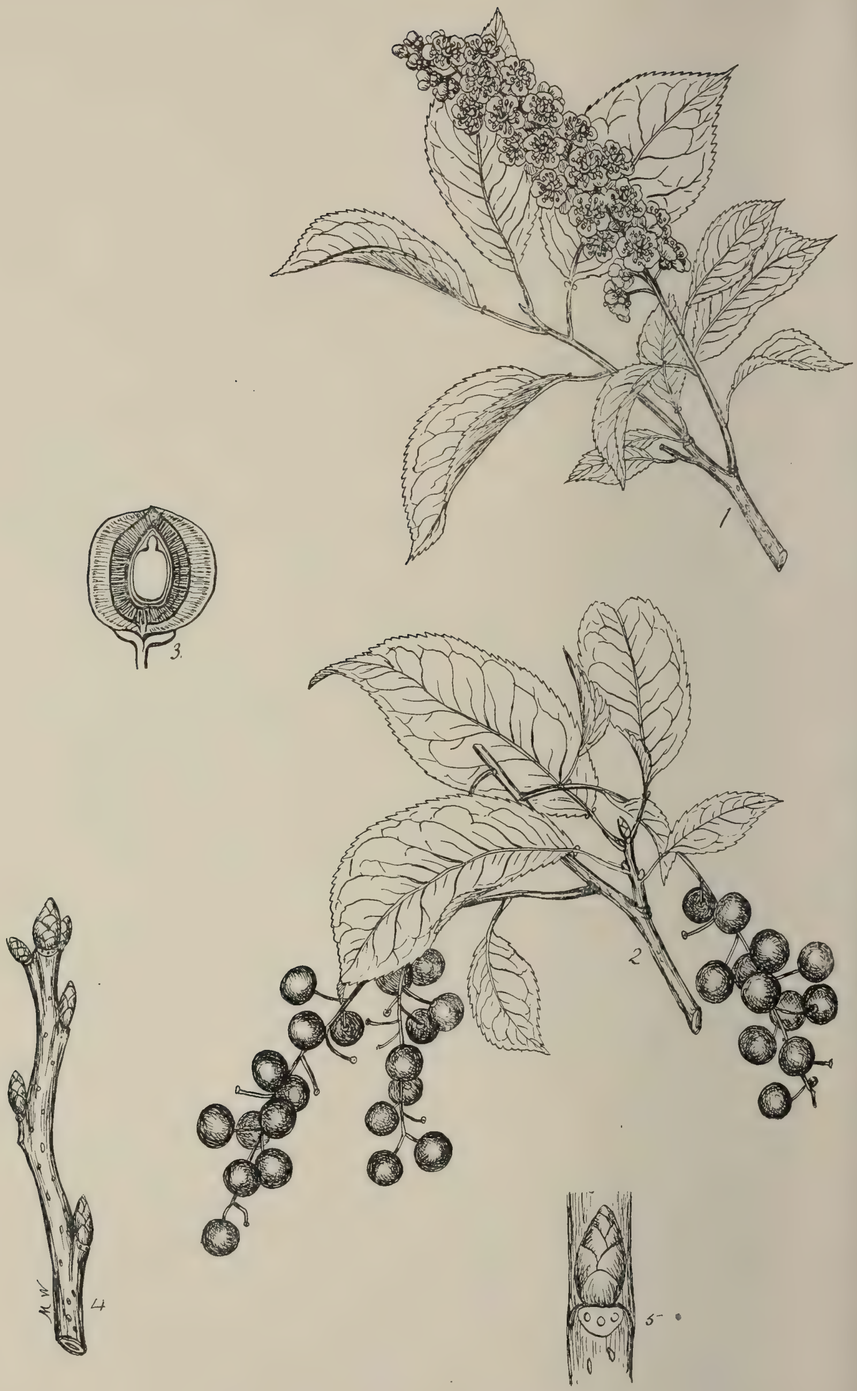

PLATE LXXXV. CHOKE CHERRY.

1. A flowering branch, x ½.
2. A fruiting branch, x ½,
3. Section of a fruit, enlarged.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

CHOKE CHERRY.

Prunus virginiana, Linnaeus.

FORM—A small tree rarely exceeding 25 ft. in height with a diameter of 8 inches. It reaches its largest size in the southern part of its geographical range.

BARK—On young trunks smooth, shiny, brownish, peels off easily in thin film-like layers and exposes the green inner bark. On older trunks about 2/5 of an inch thick, dark grayish, slightly roughened by shallow fissures. Inner layers of the bark have a very disagreeable odor.

TWIGS—Rather stout, usually smooth, light brown to reddish-brown, covered with numerous, conspicuous, dull yellowish lenticels which are not evidently horizontally-elongated; pith white. Bruised twigs have a disagreeable odor.

BUDS—Alternate, about 1/6 of an inch long, conical to ovate, smooth, sharp-pointed, brownish, covered with about 6-8 visible and closely overlapping scales. Lateral buds are often rather divergent and larger than the terminal.

LEAVES—Alternate, simple, oval, oblong or obovate, 2-4 inches long, tapering or rounded at base, abruptly pointed at apex, sharply serrate on margin with slender teeth, rather thin, bright green above, paler below.

LEAF-SCARS—Alternate, more than 2-ranked, somewhat raised on projections of twigs with a tendency to become elliptical in outline. Bundle-scars 3 in number.

FLOWERS—Appear about May when the leaves are fully developed. They are perfect, white, ½-⅓ of an inch across, arranged in many-flowered drooping racemes, 3-6 inches long.

FRUIT—A red to dark crimson juicy drupe, about ½ of an inch in diameter, arranged in rather open drooping clusters. Seed smooth and stony. Fruit is harsh and astringent.

WOOD—Similar to that of the Wild Black Cherry, only heavier and of no commercial importance. Not found on the market. Weighs 43.32 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Choke Cherry can be distinguished from the Wild Black Cherry by its smaller size, smoother and browner outer bark and an inner bark with a more disagreeable odor, as well as by its thinner and sharper serrate leaves with somewhat spreading slender teeth. The leaves of the Wild Black Cherry are thicker and moderately serrate with somewhat spreading slender teeth. The buds of the Wild Black Cherry are smaller and have rather uniformly-colored scales with a sharp apex while the buds of this species have grayish-margined scales with a rounded apex. This tree can be distinguished from the Fire Cherry by the absence of clustered terminal buds, by its stouter twigs, and by its flowers which are borne in a raceme while those of the Fire Cherry are borne in umbels. It can be distinguished from both the Wild Black Cherry and the Fire Cherry by its buff-colored lenticels which do not elongate horizontally.

RANGE—Newfoundland to Manitoba, southward to Georgia and Texas.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State but nowhere abundant. Most common in the mountainous and southeastern parts.

HABITAT—Frequently found in thickets, in open woods, along fences, in abandoned fields, along streams, and on dry situations.

IMPORTANCE OF THE SPECIES—This tree is of no commercial importance. It is rather attractive in its natural habitat and when artificially planted. Even though it has no commercial value still it need not be regarded as an objectionable forest weed because it interferes little with the growth of other trees or their utilization.

FIRE CHERRY.

Prunus pennsylvanica, Linnaeus.

FORM—A small tree reaching a height of 30 ft. with a diameter of about 10 inches. Trunk usually short bearing rather ascending branches which form a narrow and rather flat-topped crown.

BARK—On old trunks somewhat roughened but not fissured. On younger trunks about ⅛ of an inch thick, reddish-brown, rather smooth but roughened by large horizontally-elongated lenticels. The outer bark peels off readily in thin film-like layers and exposes the green inner bark which is bitter.

TWIGS—Slender, smooth, glossy, bright red, sometimes wholly or partly covered with a thin grayish coating which rubs off very readily, marked with numerous pale to yellowish and conspicuous lenticels which in time become horizontally-elongated. The twigs have a characteristic bitter taste and a peculiar odor.

BUDS—Alternate, small, usually less than ⅛ of an inch long, ovate, dull-pointed, smooth or slightly grayish, scaly, clustered at the end of twigs and often along the sides; covered with scales which are hard to distinguish. They are sometimes clustered on stubby lateral spurs.

LEAVES—Alternate or sometimes paired but not opposite each other, simple, oblong-lanceolate, 3-5 inches long, tapering or rounded at base, sharp-pointed at apex, sharply and finely serrate on margin, rather shining, green and smooth on both sides.

LEAF-SCARS—Alternate, more than 2-ranked, somewhat raised on projections of twigs, elongated, semi-elliptical in outline, with 3 bundle-scars, the central one of which is usually the largest.

FLOWERS—Appear about May when leaves are partly developed. They are white, perfect, about ½ of an inch across, borne on long stalks in 4-5-flowered umbels.

FRUIT—A globular, juicy, light red drupe about ¼ of an inch in diameter, tipped with parts of persistent styles, covered with thin skin which contains sour flesh and oblong stone. Ripens about July.

WOOD—Similar to that of the Wild Black Cherry, page 166, only lighter in weight and of no commercial importance. Not found on the market. Weighs 31.30 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Fire Cherry, also known as Wild Red, Bird and Pin Cherry, can be distinguished from Wild Black Cherry and Choke Cherry by its flowers which are borne in umbels while those of the other species are borne in racemes, and by its slender twigs bearing clustered terminal buds while those of the other species occur solitary. The bark can be distinguished from the Choke Cherry by the presence of numerous orange-colored horizontally-elongated lenticels and from the Wild Black Cherry by the absence of dark scaly plates with projecting edges.

RANGE—Newfoundland to British Columbia, southward to Georgia, Tennessee, and Colorado.

DISTRIBUTION IN PENNSYLVANIA—Common in the mountainous parts of the State, particularly among the Alleghenies. Rare or absent southeast of a line drawn from Easton through Harrisburg to Chambersburg. Also rare in the western part of the State.

HABITAT—Usually found in rocky woods and recent clearings. Very common along fences and roadsides, in abandoned fields, on lumbered and burnt-over areas, on mountain slopes and occasionally found on bottomlands.

IMPORTANCE OF THE SPECIES—This tree is of no commercial importance. It is very attractive but its short life prevents it from being planted extensively for ornamental purposes. It is rather aggressive springing up rapidly after fires and lumbering operations, often taking complete control of the situation. It is, however, a temporary species acting as a shelter or nurse tree to other more valuable species which usually follow and form the desired forest stand. The main value of this tree lies in the shelter which it gives to others and the food which it furnishes for birds and wild animals.

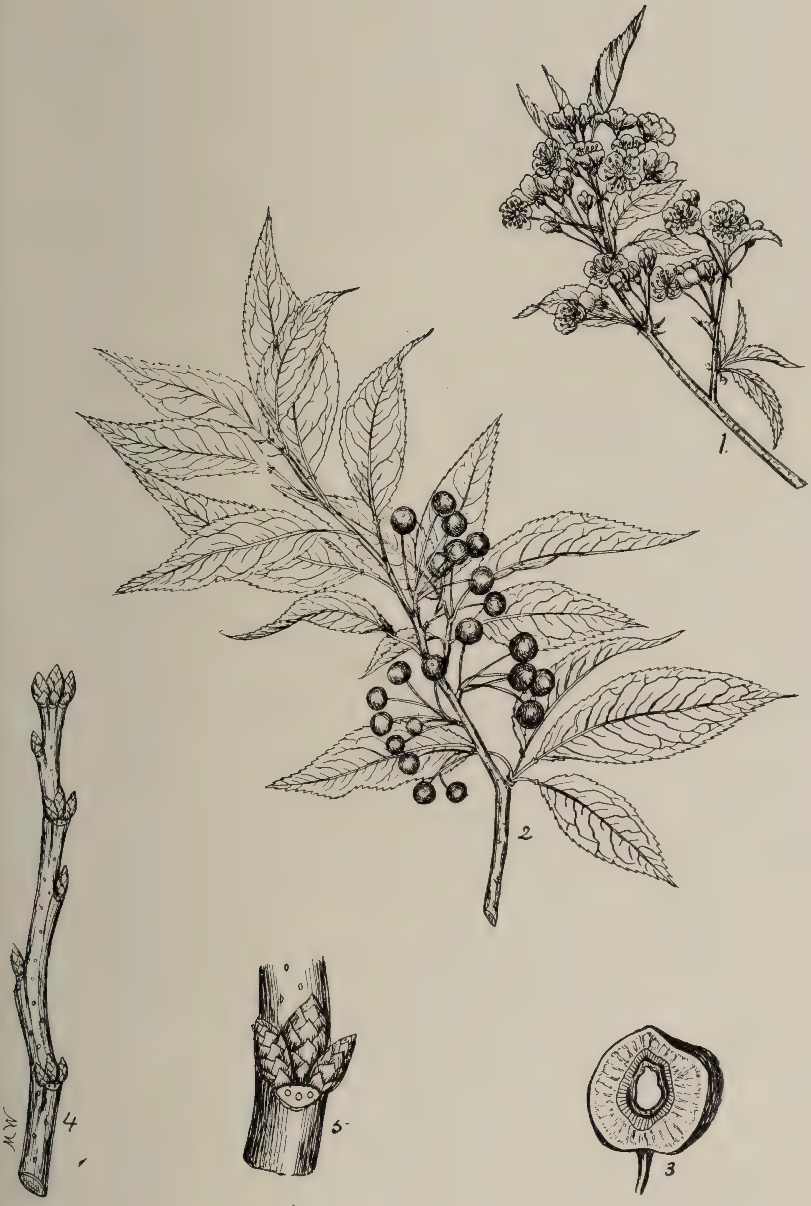

PLATE LXXXVI. FIRE CHERRY.

1. A flowering branch, x ½.
2. A fruiting branch with mature leaves, x ½.
3. Section of a fruit, enlarged.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

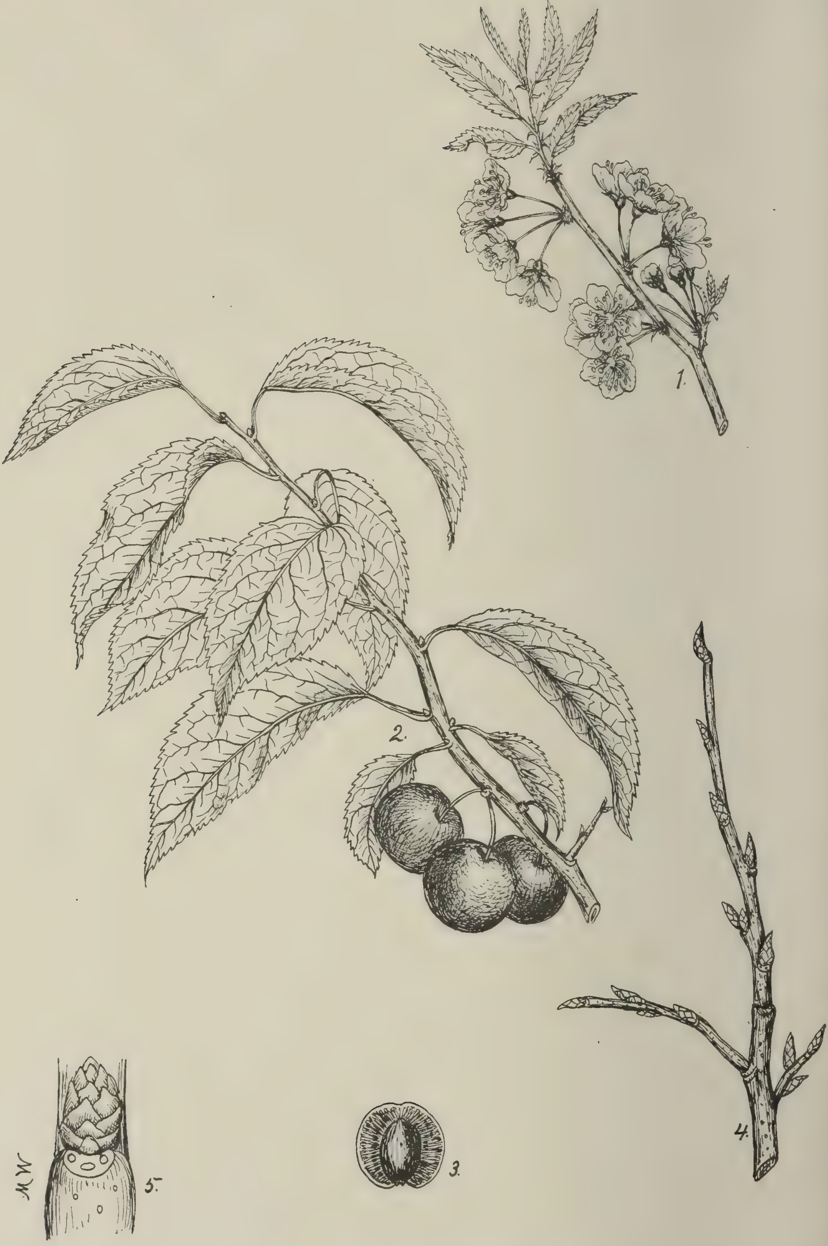

PLATE LXXXVII. WILD PLUM.

1. A flowering branch, x ½.
2. A fruiting branch, x ½.
3. **Section of a fruit, natural size.**
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.

WILD PLUM.

Prunus americana, Marshall.

FORM—A small tree from 9-30 ft. high with a diameter of 6-12 inches. Trunk short, bearing many wide-spreading, often drooping branches forming a deep and rather broad crown.

BARK—At first with a smooth grayish-brown bark, later becoming rough like the Wild Cherry by breaking up into thin dark brown plates.

TWIGS—Rather stout, at first hairy and light green, later smooth and reddish-brown, covered with a few roundish lenticels. Twigs often bear numerous spur-like spines.

BUDS—Alternate; terminal one absent; about ⅓ of an inch long, broadly conical, sharp-pointed, brown, covered with numerous triangular scales which are pale and hairy along the margin.

LEAVES—Alternate, simple, 1½-4 inches long, narrowly-obovate, taper-pointed at apex, usually rounded at base, sharply and doubly serrate on margin, firm, dark green, and rough above, paler and hairy below.

LEAF-SCARS—Alternate, more than 2-ranked, broadly crescent-shaped, with 3 conspicuous bundle-scars.

FLOWERS—Appear about May when the leaves are ⅓ developed. They are perfect, white, 1 inch across, occur on slender smooth stalks arranged in 2-5-flowered umbels.

FRUIT—Matures in late summer or early autumn. It is a subglobose drupe becoming red at full maturity, about 1 inch in diameter, with a thick tough skin and a flattened oval stone.

WOOD—Diffuse-porous; hard, heavy, strong, close-grained, reddish-brown, shiny, with thin sapwood. Weighs about 46 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Wild Plum also known as the Wild Yellow Plum and Red Plum, can be distinguished from the other members of this genus here described by the absence of a terminal bud, by the characteristic bitter aromatic taste of the twigs and by its red globose fruit about 1 inch in diameter, covered with a thick tough skin and containing a smooth oval flattened stone. Another species of Plum known as Porter's Plum or Sloe (Prunus alleghaniensis), is native to this State. It is distinguished by its purple fruit which is usually covered with a bloom, rarely over ½ of an inch in diameter and seldom spiny.

RANGE—New York south to Florida, westward to Montana, Colorado, and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the State. Most common in the southeastern and southern parts, present but rarer in other parts.

HABITAT—Prefers rather moist rich soil. Common along banks of streams and borders of woods.

IMPORTANCE OF THE SPECIES—This small tree is of no commercial importance on account of the timber which it produces, but it forms an excellent stock upon which to graft the Domestic Plum. It responds very readily to the attention which a gardener may give to it. The fruit is used for preserves and jellies. It is attractive ornamentally on account of its fine form, beautiful foliage, and profusion of attractive flowers.

COCKSPUR THORN.

Crataegus Crus-galli, Linnaeus.

GENUS DESCRIPTION—The genus Crataegus has the center of its distribution in eastern North America. It reaches its best development in the great limestone formations rather common in this part of America. Prior to 1900 fewer than 75 species were known in the world of which number about 30 were native to North America. At the present time about 700 species of trees and shrubs belonging to this genus have been described. In the State of New York alone 218 species have been described. Porter in his Flora of Pennsylvania published in 1903 records 16 species as native to this State. Only 2 species are described in this bulletin because they are practically of no commercial importance and very difficult to identify.

FORM—A small tree sometimes reaching a height of 25 ft. with a diameter of 10-12 inches. Trunk short, bearing stout and spreading branches which form a broad and rather flat crown.

BARK—Grayish to reddish-brown, sometimes roughened by small scales.

TWIGS—Smooth, rather slender, at first greenish, later light brown to gray, usually bearing straight or slightly curved and unbranched chestnut-brown thorns about 3 inches long.

BUDS—Alternate, ⅛ of an inch long, often almost spherical, very blunt-pointed; terminal bud usually present and about the same size as the laterals. Lateral accessory buds are often found at the base of a thorn. Buds are covered with numerous, thick, blunt-pointed, chestnut-brown scales.

LEAVES—Alternate, simple, obovate to elliptical, 1-3 inches long, long-tapering at base, rounded or short-pointed at apex, sharply serrate on margin except towards base; smooth, thick, and shiny on the upper surface when full grown. Petioles short and broad.

LEAF-SCARS—Alternate, more than 2-ranked, small, crescent-shaped, containing 3 bundle-scars.

FLOWERS—Appear about June when leaves are fully developed. They are perfect, white, about ⅔ of an inch across and arranged in smooth corymbs.

FRUIT—Ripens about September but persists into winter. A globose or pear-like pome, about 2/5 of an inch long, greenish or dull red, with persistent calyx lobes at apex, containing small nutlets which are rounded at the ends and 2-3 grooved on the back.

WOOD—Diffuse-porous; rays very inconspicuous; growth rings variable in width and wavy; heavy, hard, reddish-brown, close-grained. Weighs about 45 lbs. per cubic foot. Used for fence posts and fuel.

DISTINGUISHING CHARACTERISTICS—The Cockspur Thorn, sometimes also known as Newcastle Thorn, Thorn Apple, Thorn, Hawthorn, and Haw, can best be recognized by its long, usually unbranched chestnut-brown thorns, its small nearly spherical buds, its obovate to elliptical leaves with short and flattened petioles, its flowers which are arranged in corymbs, and its bright, scarlet, apple-like fruit which often persists far into winter.

RANGE—Southern Canada southward through Connecticut and Virginia to northern Georgia, westward to Michigan, Missouri, and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts of the State. Local in the other parts.

HABITAT—Common on sandy and gravelly soil. Most frequent on the foothills.

IMPORTANCE OF THE SPECIES—This species is of no commercial importance as a forest tree. It is, however, an attractive small tree which has been planted rather extensively for ornamental purposes. It is very variable in its form, leaves, flowers, and fruit. It has been planted as a hedge and in some cases has proved equal to the general requirements. The thorns were formerly used to close woolen sacks in carding mills.

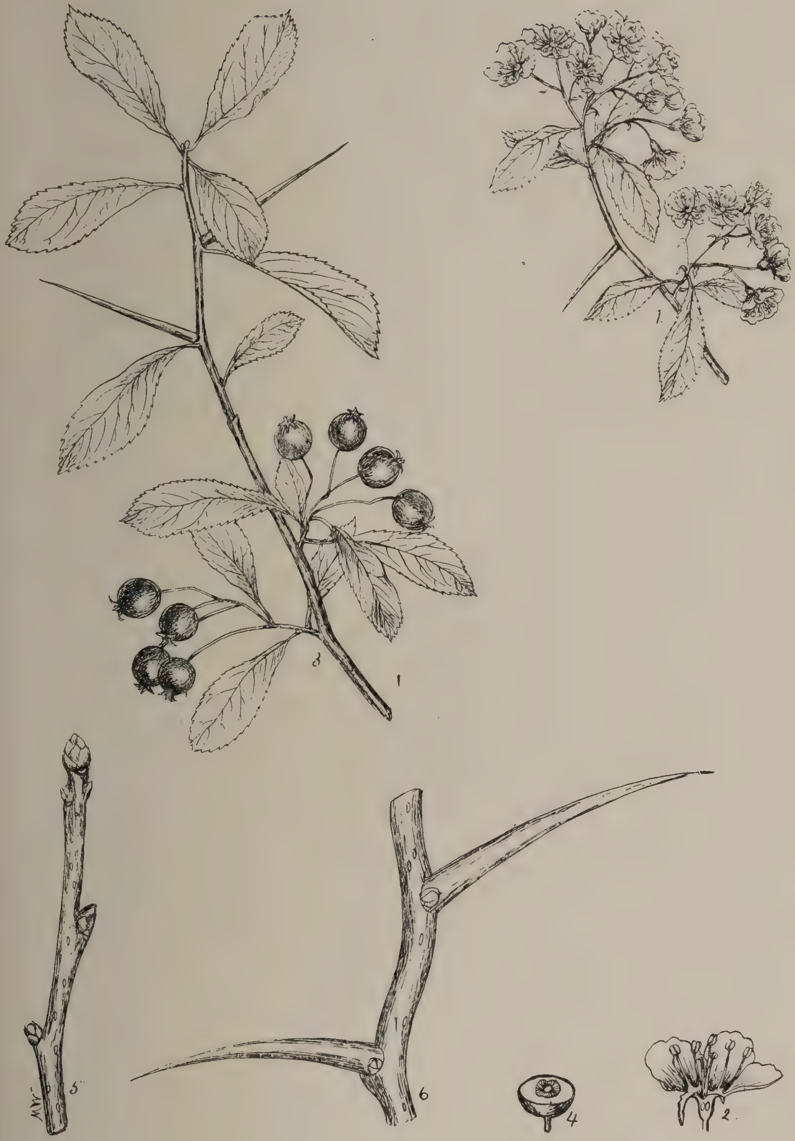

PLATE LXXXVIII. COCKSPUR THORN.

1. A flowering branch, x ½.
2. Longitudinal section of a flower, natural size.
3. A fruiting branch, x ½.
4. Section of a fruit, x ½.
5. A winter twig, natural size.
6. Section of a branch showing thorns with buds at their bases, enlarged.

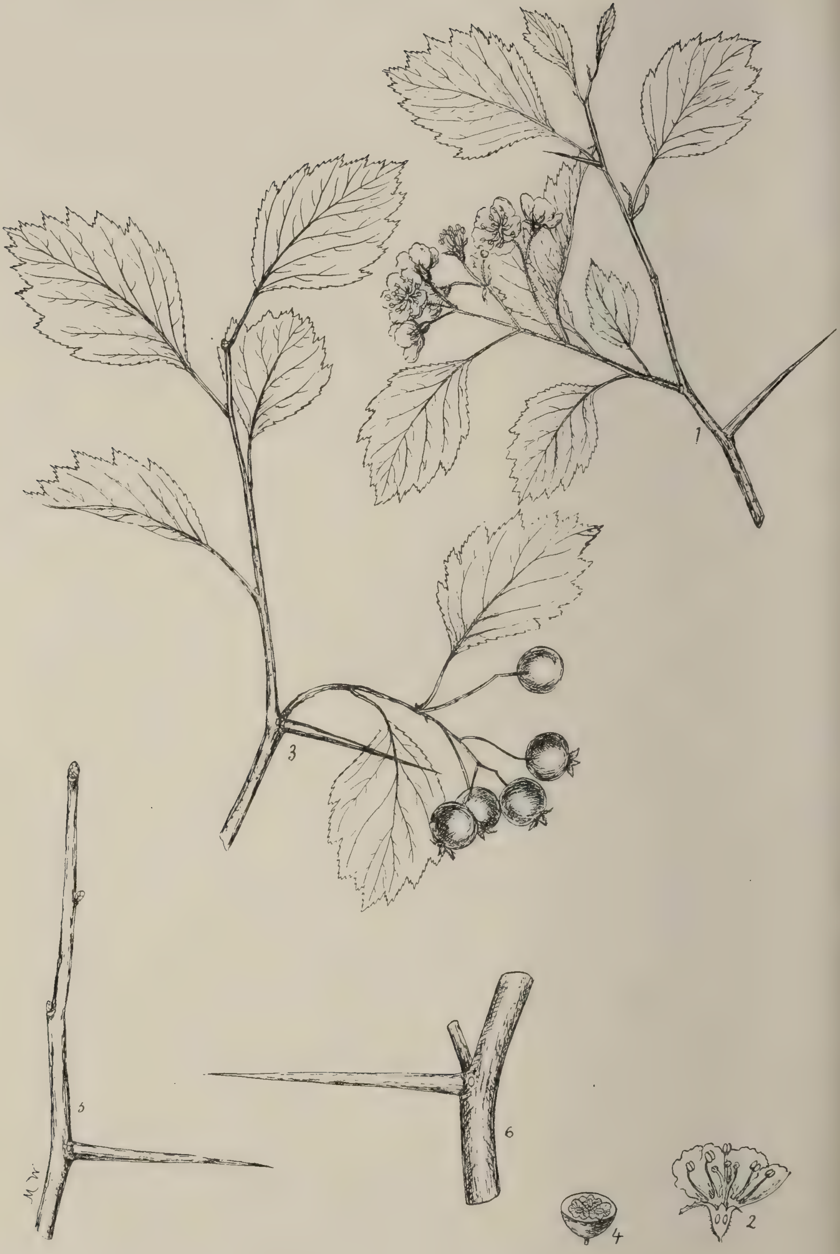

PLATE LXXXIX. SCARLET HAWTHORN.

1. A flowering branch, x ½.
2. Longitudinal section of a flower, natural size.
3. A fruiting branch, x ½.
4. Section of a fruit, x ½.
5. A winter twig with a thorn, x ½.
6. Section of a winter twig showing a thorn and a bud by its base, slightly enlarged.

SCARLET HAWTHORN.

Crataegus coccinea, Linnaeus.

FORM—A small tree rarely exceeding a height of 20 ft. with a diameter of 10 inches. Trunk short, stout, bearing rather crooked spreading branches which form a broad and flat crown.

BARK—Rather thin, light brown to ashy-gray, in time roughened by shallow fissures separating small scales.

TWIGS—Stiff, round in cross-section, at first greenish, later reddish, brownish or grayish, glossy, armed with slender usually straight, brown, glossy spines about 2 inches long.

BUDS—Alternate, about ⅛ of an inch long, often almost spherical, very blunt-pointed, covered with numerous, thick, blunt-pointed, chestnut-brown scales. Terminal bud usually present and about same size as laterals. Lateral accessory buds are often found at the base of a thorn.

LEAVES—Alternate, simple, broadly ovate, 1-5 inches long, rough-pubescent, tapering, rounded or truncate at base, often slightly 5-9-lobed or deeply cut and finely serrate on margin, pointed at apex.

LEAF-SCARS—Alternate, more than 2-ranked, small, crescent-shaped, containing 3 bundle-scars.

FLOWERS—Appear about June when leaves are almost fully developed. They are perfect, white, ½-1 inch across, with disagreeable odor, arranged in few-flowered corymbs and borne on hairy and slender stalks.

FRUIT—Ripens in September or October and is arranged in small umbels. A subglobose to ellipsoidal pome, yellowish-green, later dark reddish-brown, pubescent, about 2/5 of an inch thick, crowned with calyx lobes; containing usually 3-4 nutlets.

WOOD—Similar to that of the Cockspur Thorn, page 170, only heavier and more valuable. Used for canes, napkin rings, engraving blocks, rulers. The wood is of a high quality, taking a fine polish but the tree is small and scarce.

DISTINGUISHING CHARACTERISTICS—The Scarlet Hawthorn, also known as White Thorn, Scarlet Fruited Thorn, Thorn, Thorn Apple, and Hawthorn, can be distinguishel by its broadly ovate leaves and reddish-brown globose fruit, both of which are pubescent. The leaves are 5-9-lobed or deeply cut and finely serrate. The small nearly spherical chestnut-brown buds and the slender usually straight thorns on the branches will aid in distinguishing it from most of our native species of trees. It is next to impossible to distinguish all the species of the genus Crataegus from each other.

RANGE—Eastern Massachusetts and Vermont, southward through New York and Pennsylvania to North Carolina.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. Not so abundant in the northern and southwestern parts as elsewhere.

HABITAT—Usually found in rocky woods and old pastures with sandy or gravelly soil. Rather common along fences.

IMPORTANCE OF THE SPECIES—This species is of no commercial importance in the forest. It is, however, attractive on account of its flowers, autumnal color of its foliage, and the color of its persistent fruit.

AMERICAN CRAB APPLE.

Pyrus coronaria, Linnaeus.

GENUS DESCRIPTION—This genus embraces about 40 species of small trees and shrubs which inhabit the north temperate zone. About 10 species are native to North America and 6 to Pennsylvania. No important timber trees are members of this genus but some of our important fruit trees like the Apples and Pears belong here. Both our Common Pear and Common Apple have been introduced from Europe. Some authors make a distinct genus, Malus, for the Apples and another one, Sorbus, for the Mountain Ashes. Both are included under Pyrus in this publication.

FORM—A small tree which may attain a height of 25 ft. with a diameter of 14 inches. Trunk usually short and bearing rather slender, spreading, and crooked branches which form a rather broad round-topped crown.

BARK—Up to ½ of an inch thick, reddish-brown, roughened by longitudinal furrows which separate low ridges often covered with scales.

TWIGS—Rather stout, at first white-woolly, later smooth, reddish-brown, after first year bearing stubby spurs or sometimes sharp spines.

BUDS—Alternate, about ⅛-¼ of an inch long, bright red, blunt-pointed or on vigorous terminal shoots sharp-pointed and curved, covered with 4-8 visible scales.

LEAVES—Alternate, simple, ovate or elliptical, 3-4 inches long, usually rounded at base, sharp-pointed at apex, sharply serrate on margin, usually smooth, dark green above, pal green below. Stipules long, falling early.

LEAF-SCARS—Alternate, raised on projection of twigs, crescent-shaped; with usually conspicuous bundle-scars.

FLOWERS—Appear in May or June when the leaves are almost fully developed. Perfect fragrant, rosy-white, about 1½-2 inches across, arranged in umbel-like cymes. The flower as a whole resemble those of the Common Apple.

FRUIT—Ripens about October. Pome or apple-like, borne on long slender stalks, depressed globose, 1-1½ inches in diameter, crowned with persistent calyx lobes and filaments, yellowish green, fragrant. The flesh is clear and heavily charged with bitter malic acid. Seeds chestnut brown and shiny.

WOOD—Diffuse-porous; rays not distinct; hard, heavy, light reddish-brown. Weighs abou 40 lbs. per cubic foot. Used for carving, engraving, tool handles, and some turned articles.

DISTINGUISHING CHARACTERISTICS—The American Crab Apple closely resembles o cultivated apple only the leaves of the former are smoother, the flowers more brilliant re and the fruit smaller and very bitter. The fruit often persists far into winter and does n rot readily. It can be distinguished from the closely related Narrow-leaved Crab Apple (Pyr angustifolia, Ait.) by its persistent calyx-lobes on the fruit, and by its ovate leaf-blades whi those of the latter are usually lanceolate.

RANGE—Ontario south through South Carolina to Alabama, west to Michigan, Missouri, a northern Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Common in the southwestern part of the State. Loc outposts reported from the central and western parts of the State. Peter Kalm, a pupil Linnaeus, who traveled in America in 1753, reported this species "plentiful in Pennsylvania."

HABITAT—Usually found in thickets and open woods where rich moist soil is prese Probably occurs most frequently on little hill-tops near streams and ponds.

IMPORTANCE OF THE SPECIES—This species is of no commercial importance as a fore tree. It rarely exceeds 25 ft. in height. The fruit is used for jellies and for cider. It is a m attractive ornamental tree on account of its showy and fragrant flowers produced in gre profusion.

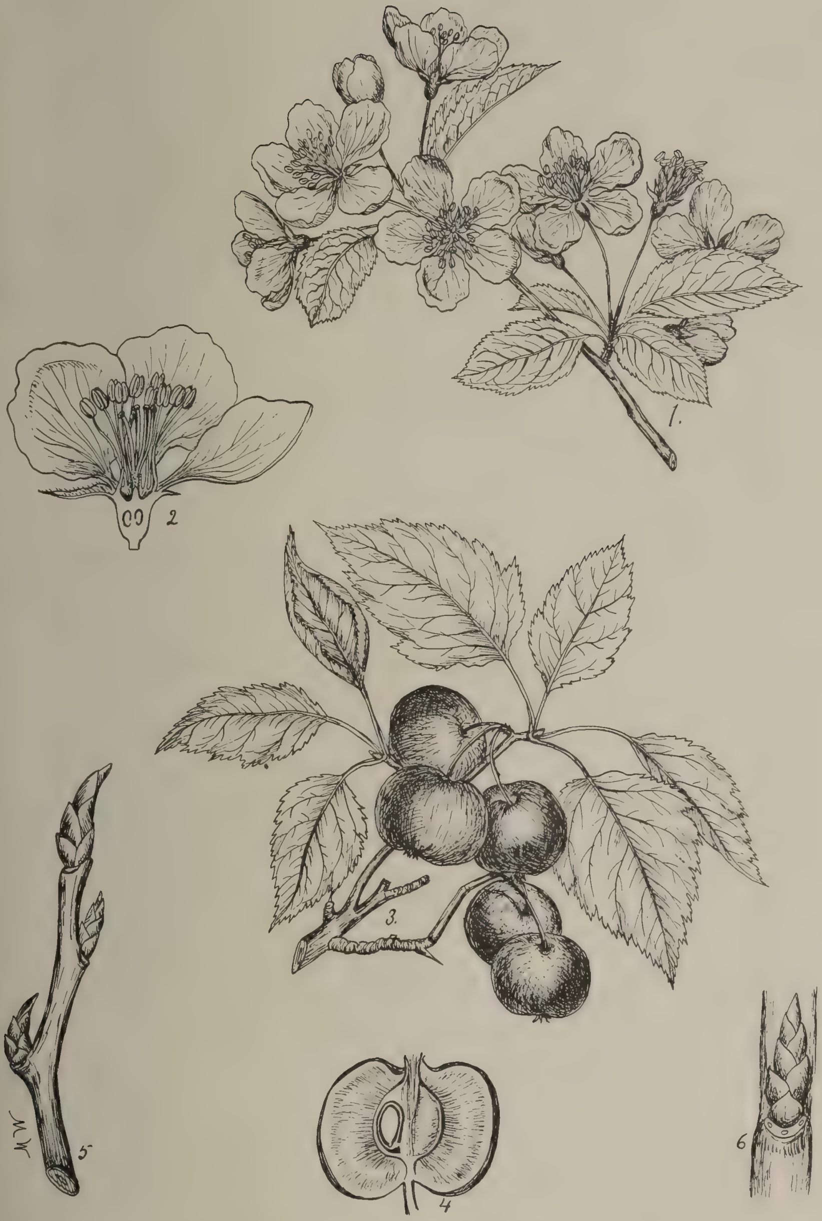

PLATE XC. AMERICAN CRAB APPLE.

1. A flowering branch, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruiting branch, x ½.
4. Section of a fruit, natural size.
5. A winter twig, natural size.
6. Section of a winter twig, enlarged.

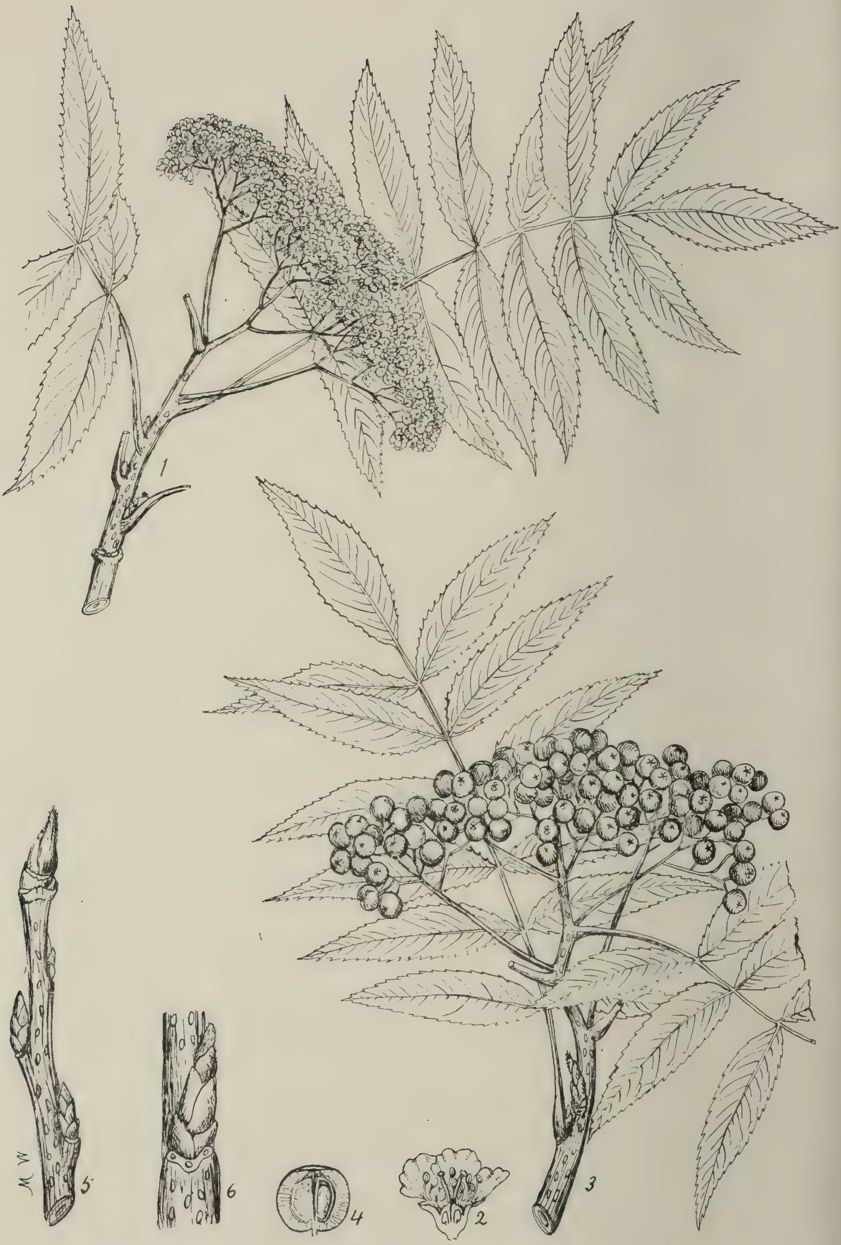

PLATE XCI. AMERICAN MOUNTAIN ASH.

1. A flowering branch with leaves, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruiting branch, x ½.
4. Section of a fruit, enlarged.
5. A winter twig, natural size.
6. Section of a winter twig, enlarged.

AMERICAN MOUNTAIN ASH.

Pyrus americana, (Marshall) De Candolle.

FORM—A small tree rarely exceeding 20 ft. in height with a diameter of 12 inches. A tree 14 inches in diameter is reported from Lycoming county. Trunk rather short and the crown narrow and round-topped.

BARK—Thin, smooth or slightly scaly and grayish.

TWIGS—Rather stout, smooth, grayish to reddish-brown, covered with conspicuous, pale, oblong lenticels, pith large, brownish.

BUDS—Alternate, purplish-red, smooth or slightly hairy on outside but densely hairy on inside; terminal buds large, about ¼ of an inch long, broadly conical, with 2-3 visible bud-scales, sharp-pointed and often curved at apex; lateral buds about ⅛ of an inch long. closely appressed, somewhat flattened, with 1-2 visible bud-scales.

LEAVES—Alternate, compound, 6-10 inches long, with 13-17 sessile leaflets. Leaflets in pairs except terminal one, lanceolate, 2-3 inches long, sharp-pointed at apex, serrate on margin, tapering or rounded at base. Smooth and dark yellowish-green when full grown, turning yellow in autumn.

LEAF-SCARS—Alternate, rather large, elevated on a projection of the twig, broadly U-shaped, with wavy margin, containing 3-5 bundle-scars.

FLOWERS—Appear about May when the leaves are fully developed. They are white, perfect, about ⅓ of an inch across, arranged in flat cymes 3-4 inches across.

FRUIT—Arranged in flat-topped clusters, persisting far into winter, berry-like, about the size of a medium-sized cherry, bright red, round or pear-shaped, in winter wrinkled, its flesh strongly acid.

WOOD—Diffuse-porous; rays indistinct; soft, weak, brownish, close-grained. Weighs about 34 lbs. per cubic foot. Not used commercially.

DISTINGUISHING CHARACTERISTICS—The American Mountain Ash can be distinguished by its alternate compound leaves with 13-17 sessile leaflets which are conspicuously toothed. The flat-topped cymes of white flowers measuring about 3-4 inches across, and the bright red fruit about the size of a pea and arranged in flat-topped clusters are characteristic. The stout grayish to reddish-brown twig with conspicuous pale lenticels and the purplish-red, sharp pointed, somewhat gummy and usually smooth alternate buds are also characteristic.

RANGE—Newfoundland westward to Manitoba and Iowa, southward in the mountains to North Carolina.

DISTRIBUTION IN PENNSYLVANIA—Limited to the mountainous region of the State. A line drawn from the western part of Tioga county south to Somerset county and thence northeast to Monroe county will include the general distribution of this species.

HABITAT—Prefers moist or rocky hillsides. Often found on the border of streams and locally common on rocky hillsides.

IMPORTANCE OF THE SPECIES—This species is of no commercial importance. It rarely exceeds a height of 20-25 ft. with a diameter of 12-15 inches. It is rather attractive and deserves to be planted for ornamental purposes. Its attractive ornamental features are its form, broad cyme-like clusters of white flowers, and its bright red clusters of fruit which ripen in autumn.

SHAD BUSH.

Amelanchier canadensis, (Linnaeus) Mendicus.

GENUS DESCRIPTION—The genus Amelanchier comprises about 30 species of small trees and shrubs found mainly in the temperate portion of the northern hemisphere. About 23 species are found in North America, 6 of which attain tree-size. Four species are native to Pennsylvania, only 1 of which attains tree-size.

FORM—A small tree usually 10-25 ft. in height with a diameter of 6-12 inches but may reach a height of 40 ft. with a diameter of 20 inches. Trunk usually straight, slender, with little taper, bearing a shallow, and narrow crown appearing very dense on account of abundant fine sprays of branchlets.

BARK—Rather smooth on young and old specimens. On older specimens there is a tendency to roughen through shallow, longitudinal, sometimes diagonal fissures which are rather dark and separate broad, lighter, and smooth ridges becoming scaly near the base.

TWIGS—Slender, somewhat zigzag, bright green to purplish-brown, smooth or often overlaid with a grayish film-like coating which peels off; covered with a few, pale, scattered lenticels; pith small, greenish, angular.

BUDS—Alternate, usually 2-ranked, slender, conical, ¼-½ of an inch long, 3-4 times as long as broad, sharp-pointed, greenish-brown often tinged with purple, sometimes smooth often hairy towards apex and along bud-scales. Terminal buds longer than lateral which are usually appressed close to twig, sometimes remaining very small. Bud-scales largest near base, often 3-nerved, darker and finely hairy along margin.

LEAVES—Alternate, simple, ovate to ovate-oblong, 3-4 inches long, sharp-pointed at apex, round or heart-shaped at base, finely and sharply serrate on margin, at first finely hairy, later smooth, dark green above, paler below.

LEAF-SCARS—Alternate, usually 2-ranked, small, inconspicuous, rather linear with projection at bundle-scars which are large and 3 in number.

FLOWERS—Appear about April when leaves are just starting to develop; large, white, perfect, stalked, arranged in drooping racemes 3-5 inches long.

FRUIT—Matures in June or July. Berry-like in racemes, reddish-purple, with a bloom when fully ripe, about ⅓ of an inch in diameter, sweet, and containing small seeds.

WOOD—Diffuse-porous; rays numerous, indistinct, dark brown often touched with red; heavy, hard, strong, checks and warps easily, very susceptible to high polish. Weighs 48.85 lbs. per cubic foot. Used to a limited extent, mainly in turnery.

DISTINGUISHING CHARACTERISTICS—The Shad Bush, also known as Service Berry, June Berry, and Sarvice, can readily be distinguished in winter by its smooth grayish often black-streaked bark and its long, slender, conical, sharp-pointed, greenish-brown to purplish buds which are often finely hairy towards the apex and along the margin of the scales. The buds, in form and to some extent in size, resemble the Beech but the buds of the Beech are usually larger, clear reddish-brown in color and have from 10-20 scales arranged in 4 rows. The twigs of the Beech are shining reddish-brown while those of the Shad Bush are usually bright green to grayish or purplish-brown. The stipule scars are absent on the Shad Bush while they nearly encircle the twig of the Beech. The large white flowers arranged in drooping racemes 3-5 inches long are also characteristic. The leaves and the fruit will aid in distinguishing it in summer.

RANGE—Newfoundland and Ontario, southward to Florida, westward to Kansas and Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Found in every portion of the State. Most abundant among the mountain ranges.

HABITAT—Occurs solitary or occasionally in clumps. Prefers open situations and moist soil, but also grows on sandy rather sterile soil. Common along the border of forests, banks of streams, forest roads, and cliffs. Small specimens common in the understory of our hardwood forests.

IMPORTANCE OF THE SPECIES—This species is of little commercial importance because its wood is rarely used. It will always be a minor species not on account of the inferiority of its wood but on account of its small size and limited and scattered distribution. The wood is actually stronger and stiffer than White Oak. Its conspicuous white flowers in early spring before the leaves are out justify its retention in the forest, especially where it does not interfere with the growth of other more valuable trees. The berries are excellent food for birds, beasts, and man.

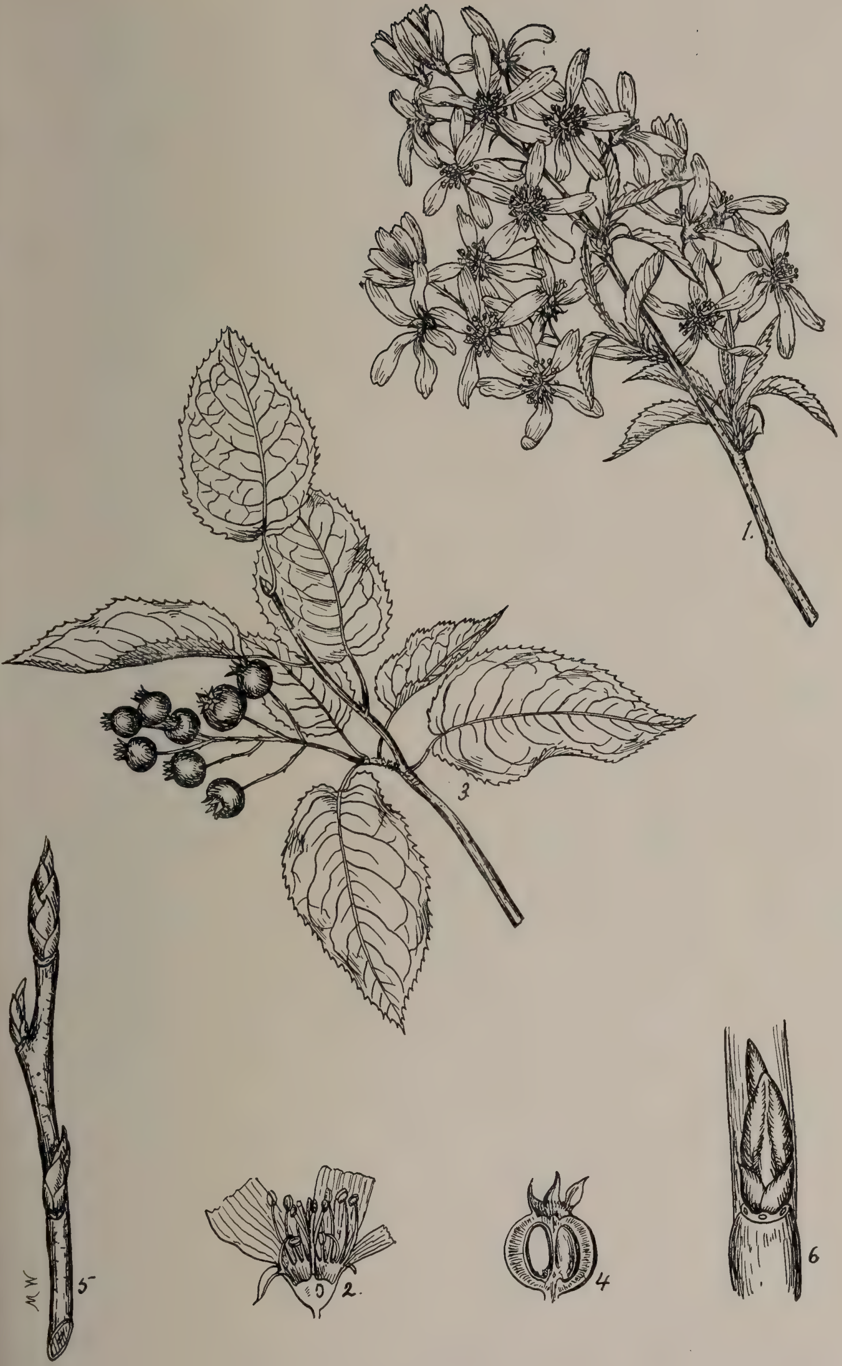

PLATE XCII. SHAD BUSH.

1. A flowering branch, x ½.
2. Longitudinal section of a flower, enlarged.
3. A fruiting branch with mature leaves, x ½.
4. Section of a fruit, enlarged.
5. A winter twig, natural size.
6. Section of a winter twig, enlarged.

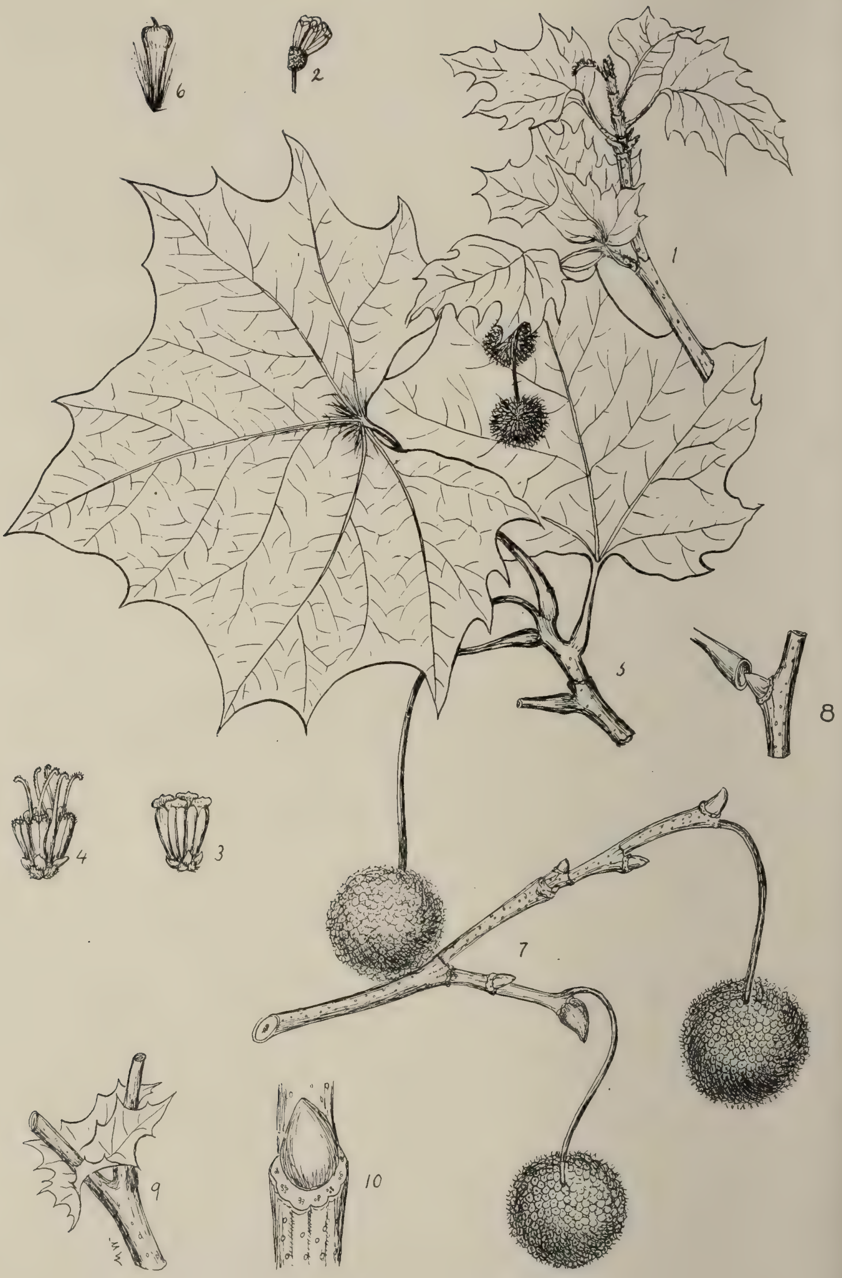

PLATE XCIII. BUTTONWOOD.

1. A flowering branch, x ½.
2. A head of flowers with most of the flowers removed, x ½.
3. A staminate flower, enlarged.
4. A pistillate flower, enlarged.
5. A fruiting branch with mature leaves, x ½.
6. An achene, enlarged.
7. A winter twig with two heads of fruit, x ½.
8. Section of a twig showing a subpetiolar bud, x ½.
9. Section of a twig showing a stipule, natural size.
10. Section of a winter twig, enlarged.

BUTTONWOOD.

Platanus occidentalis, Linnaeus.

FAMILY AND GENUS DESCRIPTION—The Plane Tree family, Platanaceae, comprises only 1 genus, Platanus, with about 7 species, 3 of which are native to the United States and 1 to Pennsylvania. In addition to the 1 species native to this State, the Old World Plane Tree (Platanus orientalis L.) is very commonly planted as a shade tree in the eastern states.

FORM—Usually attains a height of 70-125 ft., but may reach a height of 140-170 ft. with a diameter of 10-11 feet. It is the most massive of the deciduous trees of North America. Trunk usually branches near the base into heavy sub-trunks, which sub-divide and form a very deep, wide-spreading, rather open, and irregular crown.

BARK—On old trunks rather thick, rigid, roughened by shallow fissures separating broad ridges which peel off into thin dark brown scales. On young trunks and upper parts of old ones it peels off spontaneously into large thin plates exposing a whitish, yellowish, or a greenish inner bark. This mottled inner bark is characteristic, but rarely found near the ground. See Fig. 57.

TWIGS—Rather stout, zigzag, at first green and pubescent, later brownish to gray and smooth, decurrently ridged, enlarged at the nodes, marked by numerous, small, pale lenticels, encircled by stipule-scars. Pith wide and white.

BUDS—Alternate; terminal bud absent; sub-petiolar, surrounded by base of leaf-stalk or leaf-scars, ⅛-⅜ of an inch long, conical, dull-pointed, very divergent from section of branch above and slightly from section below, covered with 3 scales, the outer one of which is smooth, shining, reddish-brown, the middle green and gummy, and the inner pubescent.

LEAVES—Alternate, simple, broadly ovate, 3-5-lobed, toothed on margin, 4-10 inches across, bright green above, pale green and white woolly below. Petioles about 2 inches long, round, with enlarged hollow bases. Stipules 1½ inches long, conspicuous, encircling twig.

LEAF-SCARS—Alternate, 2-ranked, unequal in width, have a wavy outer margin, nearly encircle the buds at enlarged nodes of branches, form an angle of about 60 degrees with the section of branch below, contain 5-10 bundle-scars which are arranged in a curved line and occur singly or in groups.

FLOWERS—Appear in dense heads with the leaves in May. Staminate and pistillate flower heads occur on different stalks. Staminate are axillary and dark red; pistillate terminal, greenish and often tinged with red.

FRUIT—Matures in October. Occurs solitary or rarely in 2s in brown heads about 1 inch in diameter suspended from a slender stalk. Heads often persist far into winter and are composed of many hairy achenes about ¾ of an inch long.

WOOD—Diffuse-porous; rays conspicuously broad; pores minute; hard, difficult to split, reddish-brown with light to yellowish sapwood. Weighs 35.39 lbs. per cubic foot. Used in the manufacture of furniture, interior furnishing, crates, tobacco boxes, and charcoal.

DISTINGUISHING CHARACTERISTICS—The Buttonwood, also known as Buttonball, Sycamore, and Plane Tree, can readily be distinguished in summer by its massive form, its whitish, yellowish, or greenish bark of the upper branches which at times are covered with large, thin, dark brown scales of outer bark. The large leaves with their enlarged hollow-based petioles and the flowers in the form of heads, are also characteristic. In winter the massive form and whitewashed appearance of the upper branches is distinctive. The smooth, reddish, sub-petiolar buds covered by a single exposed scale and surrounded by a leaf-scar with 5-10 bundle-scars will prevent one from confusing it with any other of our native species. The persistent fruit which usually occurs solitary is readily distinguished from the oriental species which bears its fruit in clusters of 2-4.

RANGE—Maine and Ontario south to Florida, west to Minnesota, Nebraska and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common along streams, especially in the eastern, southern, and central parts of the State.

HABITAT—Prefers moist, fertile soil, but will grow in rather dry soil. Best development in the moist valleys of the Ohio and Mississippi rivers.

IMPORTANCE OF THE SPECIES—The wood of this species is annually becoming of more commercial importance and hence it should be planted at least to a limited extent. It may be grown from cuttings or from seed. It is planted sparingly for ornamental purposes but the Oriental Sycamore seems to be preferred since it is more attractive and less subject to fungous diseases.

THE PULSE FAMILY—LEGUMINOSAE.

This is a very large family and contains many well-known trees, shrubs, and herbaceous plants. It comprises about 460 genera with 7,350 species of which number more than 100 genera with about 1,400 species are native to North America. The flora of Pennsylvania comprises about 32 genera with approximately 90 species but only 4 species belonging to 4 different genera can be classified as trees. Some authors separate the members of this family into 3 distinct families known as: (1) The Mimosa family, Mimosaceae, (2) The Senna family, Caesalpiniaceae, and (3) The Pea family, Fabaceae.

Many domestic and foreign plants which belong to this family are of considerable economic importance. Some of our native trees produce very heavy, hard, and strong wood. They possess additional merits in that they grow rapidly and are well adapted to artificial propagation. Some of them, in particular the Common Locust, are subject to the attack of destructive insects and fungi. Some of the shrub members of this family are among the most attractive that one can find for ornamental planting. The herbaceous members comprise some of the commonest and most valuable food and forage plants of the world, such as the peas, beans, clover, and the common peanut. Among the valuable products which some of the foreign members of this family produce one can mention Senna and Logwood. Senna is prized on account of its laxative properties and is derived from the leaves of a few African species of Cassia. Logwood, the most important of vegetable dyes, is derived from the heartwood of the trunk and roots of a tree growing in the West Indies and Central America. Indigo, one of our important and widely used dyes, is also obtained from a member of this family. The well-known Sensitive Plant (Mimosa pudica L.) so common in our greenhouses and a mere weed in the tropics is one of the most widely known and interesting representatives of this family. In addition they comprise a great number of plants which are important on account of the medicinal properties derived from them. Probably one of the greatest values which we can attach to some of the members of this family is the means which they have at their command for restoring nitrogen to barren land. If one examines the roots of clover, alfalfa, soy bean, or the Common Locust he may find little swellings or enlargements upon them known as root tubercles. These swellings are caused by bacteria which possess the power of taking free nitrogen from the air and by means of complicated chemical changes passing it to members of this family. As a result these plants can be grown upon soils very deficient in nitrates. In addition they will return sufficient nitrogen to the soil so that companion or subsequent crops will thrive which would have barely existed without the nitrogen The Common Locust often thrives on old abandoned mud-dams found about ore mines while other more aggressive species fail even to establish themselves.

The members of this family are distinctly characterized by their fruit which matures in one season and usually resembles ordinary garden beans or peas. The fruit of some of the trees found in the western part of North America varies more or less from the typical bean-like fruit pod. The flowers of our native trees may be irregular in form, i. e. pea-like or bean-like, as in the Common Locust and Redbud, or regular in form as in the Honey Locust and Kentucky Coffee Tree. The two native tree-species with irregular flowers have also perfect flowers, i. e. flowers with both the male (pollen producing) and female (seed producing) organs in the same flower while the other two native tree-species have regular but imperfect flowers, i. e. flowers with one sex so suppressed that only the other sex remains in each flower. Whenever the male and female flowers, also known as staminate and pistillate flowers respectively, occur separately, they may be found on the same branch, or on the same tree, or on different trees. The leaves of nearly all the tree members of this family are alternate and compound, but a few such as our native Redbud have simple leaves. Some species as our Common Locust are normally only once compound, others as the Honey Locust may be once or twice compound, while still others, as the Kentucky Coffee Tree, may be normally twice compound.

SUMMER KEY TO THE GENERA.

Page.

1. Leaves simple; twigs slender and unarmed, ...Cercis 180
1. Leaves compound; twigs stout or armed with spines or thorns, ...2

2. Twigs very stout and clumsy but not armed with spines or thorns; fruit-pods woody; leaves twice compound, from 1-3 ft. long, ...Gymnocladus 178
2. Twigs relatively slender and armed with spines or thorns; fruit-pods leathery; leaves usually once or sometimes twice compound, rarely over 1 ft. long, ...3

3. Flowers greenish, regular or nearly so, imperfect, in axillary spikes; leaves once or twice compound, even-pinnate; twigs, branches, and often trunks with long branched thorns ....Gleditsia 179
3. Flowers whitish, irregular, perfect in drooping racemes; leaves usually once compound, odd-pinnate; twigs often with two short spines at nodes, ...Robinia 181

WINTER KEY TO THE GENERA.

1. Twigs, branches, and trunks usually armed with spines or thorns, ...2
1. Twigs, branches, and trunks without spines or thorns, ...3

2. Twigs and branches armed with a pair of spines not exceeding ½ of an inch in length at each node; fruit-pods 2-4 inches long, ½ of an inch broad; bark reddish-brown, even on young trunks deeply furrowed, ...Robinia 181
2. Twigs, branches, and often trunks usually armed with thorns which occur singly, are often branched and usually much exceed ½ of an inch in length; fruit-pods 10-18 inches long, 1-1⅓ inches wide; bark grayish-brown to black, not furrowed, often covered with conspicuous oblong lenticels, ...Gleditsia 179

3. Twigs stout, clumsy, blunt-pointed, with large conspicuous bundle-scars and large pink to brown pith; fruit-pods thick, woody, stubby, contain fleshy pulp and large seeds; buds silky-pubescent, depressed, uppermost one surrounded by incurved hairy ring of bark, ...Gymnocladus 178
3. Twigs slender, not clumsy nor blunt-pointed, with inconspicuous bundle-scars and pith with reddish longitudinal streaks; fruit-pods very thin, leathery, without fleshy pulp, and contain small seeds; buds smooth, not depressed, often somewhat flattened and appressed, ...Cercis 180

KENTUCKY COFFEE-TREE.

Gymnocladus dioica, (Linnaeus) Koch.

GENUS DESCRIPTION—This genus comprises only 2 species, one Gymnocladus chinensis a native of southern China, and the other described here. The generic name Gymnocladus is of Greek origin and means "naked branch" referring to the stout clumsy branches which are devoid of foliage for about 6 months of the year.

FORM—A medium-sized tree usually 40-80 ft. in height with a diameter of 1-2 ft. but may reach a height of 100 ft. with a diameter of 3 feet. Trunk usually short, soon subdividing into 2 or 3 secondary nearly parallel stems. Crown narrow obovate, composed of very stout branchlets.

BARK—Of medium thickness, dark gray to dark brown, roughened by shallow fissures separating low ridges covered with thin recurved scales.

TWIGS—Very stout, blunt-pointed, greenish-brown, often coated with a whitish crusty film, occasionally covered with fine hairs, and marked with large conspicuous lenticels usually most numerous on the second year's growth. Pith large, pink to brown in color.

BUDS—Alternate; terminal bud absent; small, downy, imbedded in twig so that it scarcely projects beyond surface, surrounded by incurved hairy ring of bark, superposed. The uppermost bud is the largest; the lowest is small and located in the depression at top of leaf-scar.

LEAVES—Alternate, twice compound, 1-3 ft. long, 1½-2 ft. broad, with 7-13 foliate pinnae; 1-2 basal pairs of pinnae are reduced to entire leaflets. Pinnae have 3-7 pairs of leaflets. Leaflets ovate, 2-2½ inches long, wedge-shaped to rounded at base, sharp-pointed at apex, entire to wavy on margin.

LEAF-SCARS—Alternate, more than 2-ranked, large, conspicuous, raised on projections of twigs, broadly heart-shaped, paler in color than surrounding twig; contain 3-5 large, raised bundle-scars.

FLOWERS—Appear about June. Regular, polygamus, or dioecious by abortion. Staminate flowers greenish-white and arranged in a raceme-like corymb about 3-4 inches long. Pistillate flowers greenish-white and arranged in terminal racemes 6-8 inches long.

FRUIT—A broad, flat, thick, stubby, reddish-brown pod, 4-10 inches long, 1-2 inches broad, sometimes covered with a grayish bloom. Pods often persist far into winter and remain closed. Seeds dark brown, flat, 6-9 to a pod, over ½ of an inch across, surrounded by a somewhat sticky sweet pulp.

WOOD—Ring-porous; pores in spring wood large, in late wood small; rays distinct but not conspicuous; heavy, not hard, strong, coarse-gained, light brown to reddish-brown, durable in contact with soil; takes a fine polish. Weighs about 43 lbs. per cubic foot. Used for fence posts, fence rails, and occasionally in construction.

DISTINGUISHING CHARACTERISTICS—The Kentucky Coffee-tree, also known as Mahogany, Coffee Nut, and Nicker Tree, can be distinguished by its large twice compound leaves, its stout, clumsy, unarmed branches marked with large leaf-scars and containing pink to brown pith, and by its thick, stubby, and woody fruit-pods. The superposed, depressed, silky buds, the uppermost of which is surrounded by an incurved hairy ring of bark, are also characteristic.. In general it resembles the Ailanthus but it can be distinguished from it especially by its curious bark, its characteristic fruit, and the parallelism of its primary branches.

RANGE—Central New York south, to Tennessee and westward to Minnesota and Indian Territory. It is absent from many localities within this range.

DISTRIBUTION IN PENNSYLVANIA—Planted extensively as an ornamental tree but usually known under the name of Mahogany. Franklin county is the only part of the State where it is reported as a native tree.

HABITAT—Rich woods and bottomlands. Always occurs solitary, never in clusters or stands. Often only a single tree known in a locality. When planted it will grow practically anywhere in the State.

IMPORTANCE OF THE SPECIES—This tree is of no commercial importance, especially in this State where it is very rare. It is regarded rather attractive as an ornamental tree and is planted extensively in this State. It loses its leaves early in autumn and develops them late in spring.

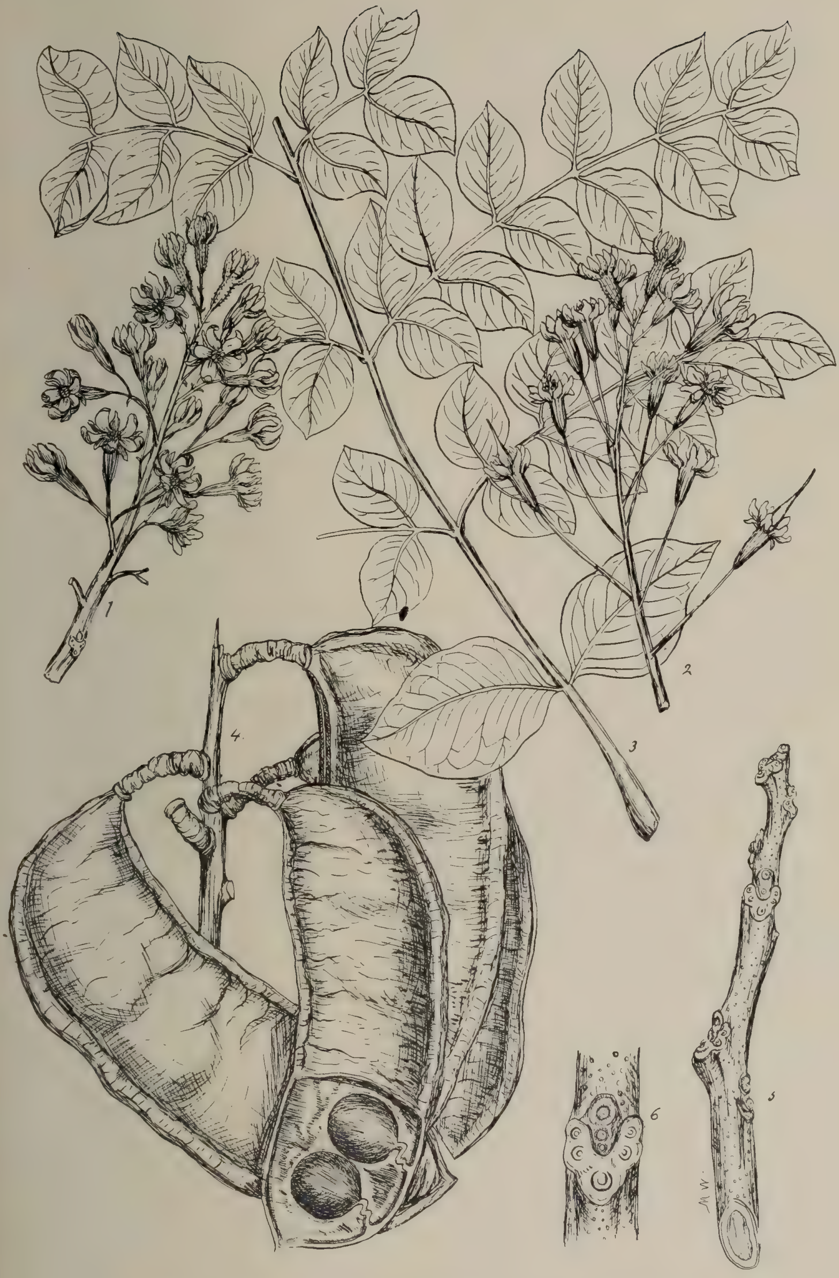

PLATE XCIV. KENTUCKY COFFEE-TREE.

1. Staminate flowers, x ½.
2. Pistillate flowers, x ½.
3. Portion of a doubly compound leaf, x ½
4. Fruit pods with portion of one pod removed showing two seeds, x ½.
5. Section of a winter twig showing superposed and inconspicuous buds, lenticels, pith, and leaf-scars with bundle-scars, x ½.
6. Section of a winter twig, slightly enlarged.

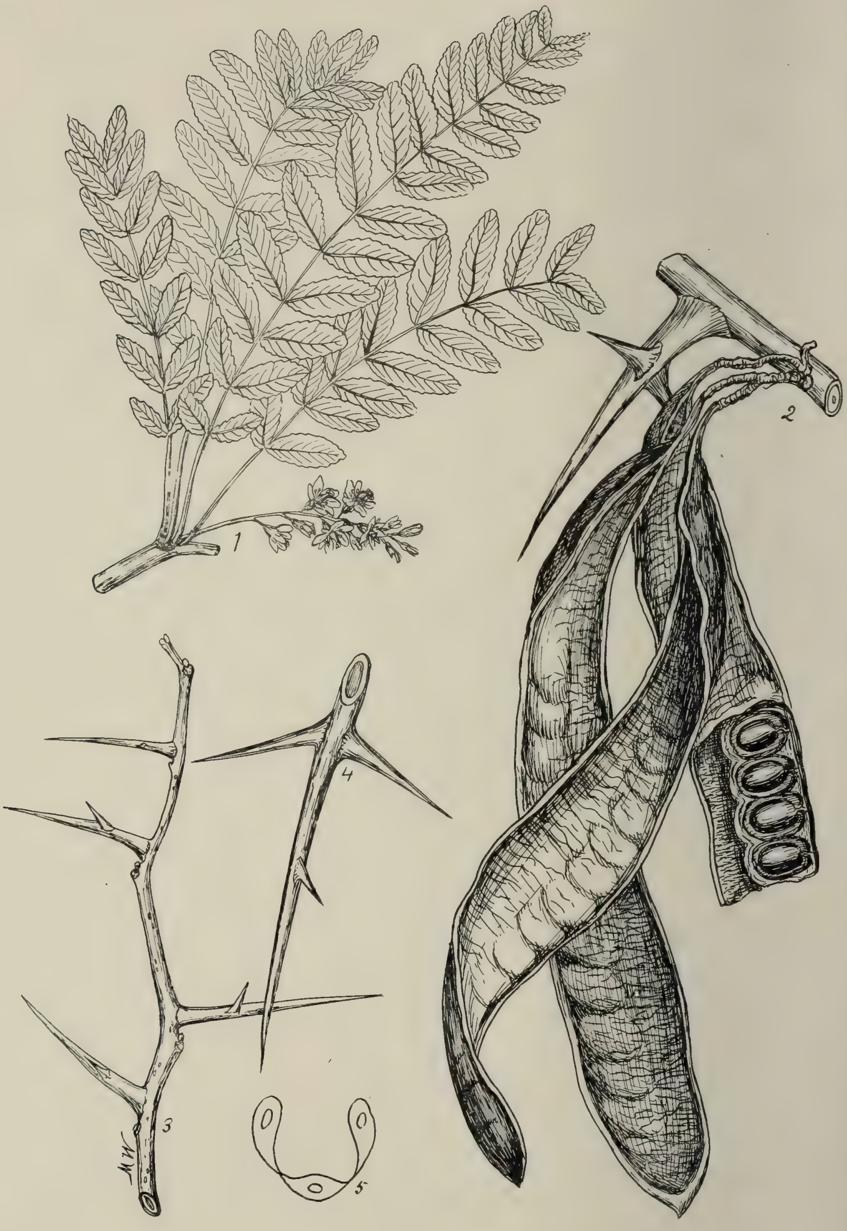

PLATE XCV. HONEY LOCUST.

1. Flowering branch with mature leaves, x ½.
2. Section of a branch with fruiting pods and a branched thorn, x ½.
3. A winter twig with thorns, x ½.
4. A branched thorn, x ½.
5. A leaf-scar, enlarged.

HONEY LOCUST.

Gleditsia triacanthos, Linnaeus.

GENUS DESCRIPTION—This genus comprises about 11 species of trees which are usually armed on the branches and trunk with simple or branched thorns. They are distributed in the temperate part of Asia and eastern North America. Fossil representatives of this genus have been reported from Europe. Three species are native to eastern North America, one inhabiting Texas, one the southern and south-central United States, and one described here. The generic name is in commemoration of the German botanist, John Gottlieb Gleditsch.

FORM—A medium-sized tree usually from 40-50 ft. high with a diameter of 1-2 ft. but may reach a height of 140 ft. with a diameter of 4-6 feet. Trunk usually short but when grown in very close stands may be rather clean and long. Crown broad, obovate, round-topped, high on account of lateral drooping branches.

BARK—On young trunks smooth covered with many, very conspicuous, raised, oblong lenticels; on old trunks grayish-brown to almost black, sometimes smooth but usually roughened by a few fissures and thick, firm, broad ridges with projecting edges. Bark on trunks is often covered with many thorns. See Figs. 59 and 94.

TWIGS—Rather stout, zigzag, smooth, glossy, with enlarged nodes; greenish-red to brown, covered with few, small, scattered lenticels which become larger in time; pith thick and white. Twigs frequently bear thorns which are often branched and contain reddish-brown pith.

BUDS—Alternate; terminal bud absent; small, usually 3-5 at a node, placed one above another; upper ones scaly and visible, lowest one not scaly, nor visible except as a dot. Some buds are slow in developing.

LEAVES—Alternate, singly or doubly compound, 7-8 inches long. Petioles flattened, grooved above, enlarged at base. When singly compound with 18-28 leaflets; when doubly compound with 8-14 pinnae and each with usually 18-20 leaflets. Leaflets lanceolate-oblong, 1½-2 inches long, rounded at the base and apex, somewhat serrate on margins.

LEAF-SCARS—Alternate, 2-ranked or more than 2-ranked, U-shaped; varying in width; broadest about the 3 bundle-scars and narrower between.

FLOWERS—Appear about May or June. Polygamus, small, greenish. Staminate flowers arranged in short hairy racemes with short stalks. Pistillate flowers in few-flowered, rather elongated and solitary racemes.

FRUIT—A more or less twisted, flat, and reddish-brown pod, 10-18 inches long, containing many flat, oval, brownish seeds. The pods are thin, do not split open, often persist into winter, and occasionally are produced in large numbers.

WOOD—Ring-porous; rays conspicuous on account of their brilliancy; hard, strong, heavy, durable in contact with the soil; heartwood bright reddish-brown with thin pale sapwood. Weighs about 42 lbs. per cubic foot. Used mainly for fence posts and rails, hubs of wheels, and general construction. In time its use will be extended and it may be grown for timber.

DISTINGUISHING CHARACTERISTICS—The Honey Locust, also known as the Sweet Locust, Thorn Tree, Three-thorned Acacia, and Honey Shucks, can be distinguished by its large branched thorns located above the leaf-scars. A thornless variety is, however, known. The once-compound or sometimes twice-compound evenly-pinnate and alternate leaves together with the leathery fruit-pod from 10-18 inches long and the grayish-brown to black bark often covered with conspicuous oblong lenticels are also characteristic. A longitudinal section of a twig just above the origin of a leaf or a leaf-scar will usually show five separated and superposed buds, the upper scaly and externally visible, the lowest not scaly and hidden beneath the bark.

RANGE—Ontario through Pennsylvania to Florida, westward to Kansas and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found as a native or planted tree in all parts of the State. Its original distribution in this State was limited almost entirely to the region west of the Allegheny Mountains, except a few local outposts east of them. At present it is common as a planted tree in the entire eastern portion of the State and in many places has escaped cultivation.

HABITAT—It develops best in rich soil along moist river bottoms but will grow in any fertile soil which is not too wet. It demands plenty of light.

IMPORTANCE OF THE SPECIES—This tree is of little commercial importance as a timber tree in Pennsylvania because it is limited in its distribution. Most of the existing trees of this State are open grown and not forest grown, therefore, too knotty to be of any commercial value. If properly planted it will produce excellent wood. It grows rapidly, is free from insect and fungal enemies, has an attractive form, and bears graceful foliage. The leaves come out late in spring and, hence, it is not of much value for shade.

REDBUD.

Cercis canadensis, Linnaeus.

GENUS DESCRIPTION—This genus comprises 7 species of small trees and shrubs found in parts of Asia, Europe and North America. Three species are native to North America, 1 inhabiting California, 1 Mexico and Texas, and 1 eastern United States. The latter is native to Pennsylvania and described here. They are prized mainly on account of their ornamental value due to their bright rose-colored, pea-like flowers which cover the branches with a profuse and brilliant flame of color in early spring before the leaves come out.

FORM—A small tree usually about 15-20 ft. high with a diameter of 6 inches but may reach a height of 50 ft. with a diameter of 18 inches. Trunk short bearing rather upright branches which form a shallow and broad crown.

BARK—Thin, shallowy fissured separating ridges which peel off into numerous scales, reddish-brown to very dark brown. See Fig. 56.

TWIGS—Slender, smooth, light brown, becoming grayish-brown, covered with numerous very small lenticels, containing pith which sometimes has reddish longitudinal streaks.

BUDS—Alternate; terminal one absent; small, ⅛ of an inch long, blunt-pointed, dark purplish-red, spherical or somewhat flattened when appressed. Sometimes superposed with upper one usually the larger, or clustered at the base of a lateral branch, covered with 2-3 visible scales with hairy margin.

LEAVES—Alternate, simple, rounded or heart-shaped, 3-5 inches long, conspicuously 5-7 nerved, cordate at base, pointed at apex, entire on margin.

LEAF-SCARS—Alternate, 2-ranked, inversely triangular to heart-shaped, somewhat raised, containing 3 conspicuous bundle-scars. Short spreading ridges often originate at outer margin of the leaf-scars and extend down the stem for a short distance.

FLOWERS—Appear in March or April before the leaves or sometimes when the leaves are just appearing. Resemble the sweet pea in form; perfect and brilliant red, borne usually in clusters of 4-8, often developing from buds located at the base of lateral branches as well as from buds located along the branches.

FRUIT—A small, rose-colored to light brown, short-stalked pod, 2½-3 inches long, about ½ of an inch wide, containing about 6 broadly ovate, flattened, light-brown seeds. Pods may persist until early winter and are often produced in enormous quantities.

WOOD—Ring-porous; heavy, hard, not strong, rich dark reddish-brown with light sapwood. Weighs 39.65 lbs. per cubic foot. Not found on the market.

DISTINGUISHING CHARACTERISTICS—The Redbud, also known as the Judas Tree, can be distinguished by its simple alternate and heart-shaped leaves, its slender unarmed and light brown twigs with reddish-streaked pith, its small, thin, leathery fruit-pods, and its perfect, pea-like, brilliant red blossoms which occur in clusters of 4-8, appearing in early spring before the leaves and developing from a cluster of buds located at the base of a lateral branch as well as from buds located along the twigs. This is the only tree native to this State which develops a cluster of purplish flower buds on a branch just below the origin of a lateral twig.

RANGE—Ontario through New Jersey to Florida, westward to Minnesota and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Not known to occur in the northern or eastern parts of the State. Reported from the southeastern, southern, central and western parts. Common in the Schuylkill and Perkiomen Valleys and along parts of the Susquehanna River Valley, especially northwest and southeast of Harrisburg. Common about Gettysburg, and south of Chambersburg in the Cumberland Valley. Occurs in a dense pure stand covering about one acre southwest of Gettysburg.

HABITAT—Prefers rich moist soils. Common in abandoned fields, cut-over and open woodlands. Also found in the understory of the forest. Endures shade but prefers plenty of light.

IMPORTANCE OF THE SPECIES—This tree is of no commercial importance as a forest tree but where a tall shrub or a small tree is desired for ornamental planting hardly a more attractive one could be found. It has a pleasing form at all seasons of the year, an exceptionally beautiful and abundant bloom in spring before the leaves come out, and in addition, grows rapidly. It is cultivated extensively in Europe as an ornamental tree.

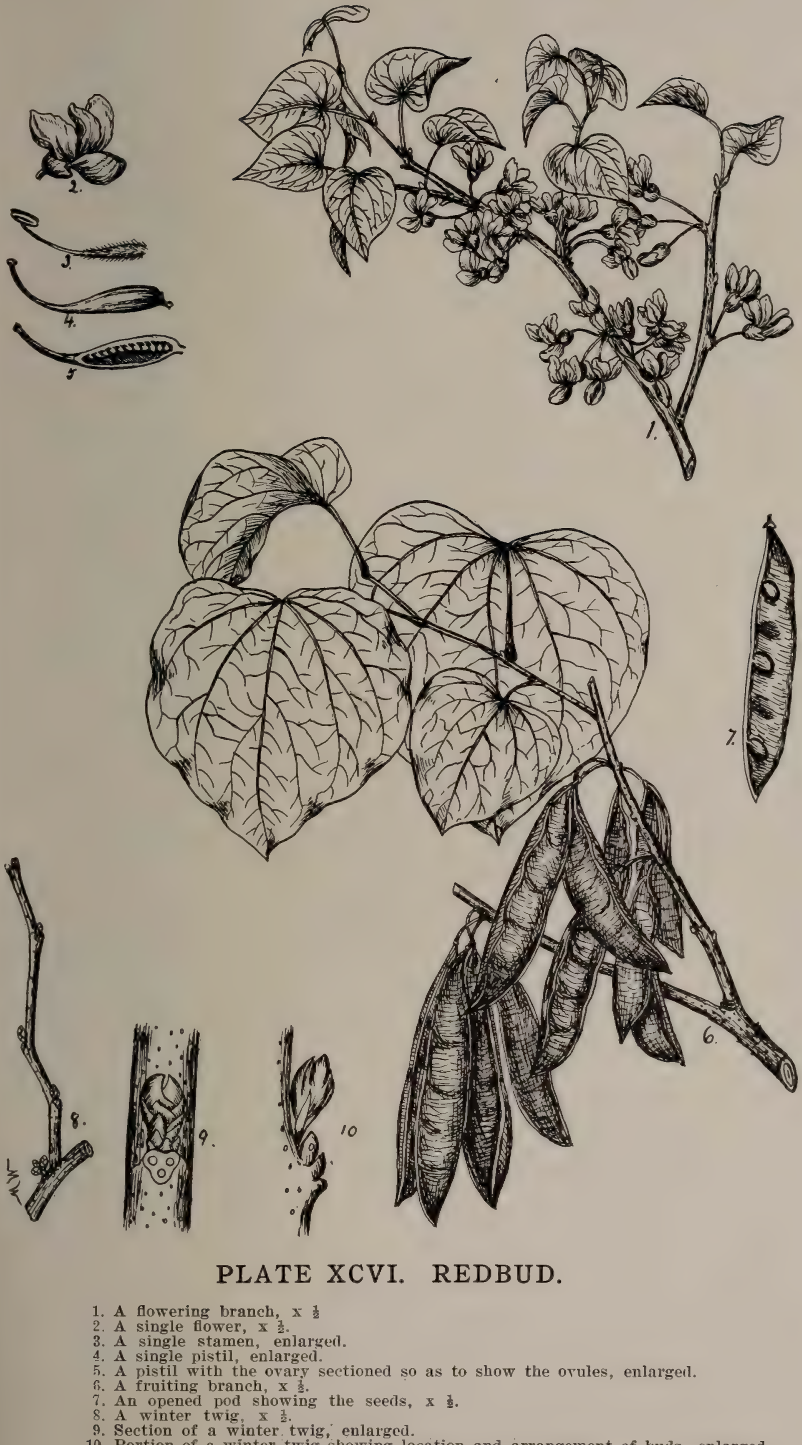

PLATE XCVI. REDBUD.

1. A flowering branch, x ½
2. A single flower, x ½.
3. A single stamen, enlarged.
4. A single pistil, enlarged.
5. A pistil with the ovary sectioned so as to show the ovules, enlarged.
6. A fruiting branch, x ½.
7. An opened pod showing the seeds, x ½.
8. A winter twig, x ½.
9. Section of a winter twig, enlarged.
10. Portion of a winter twig showing location and arrangement of buds, enlarged.

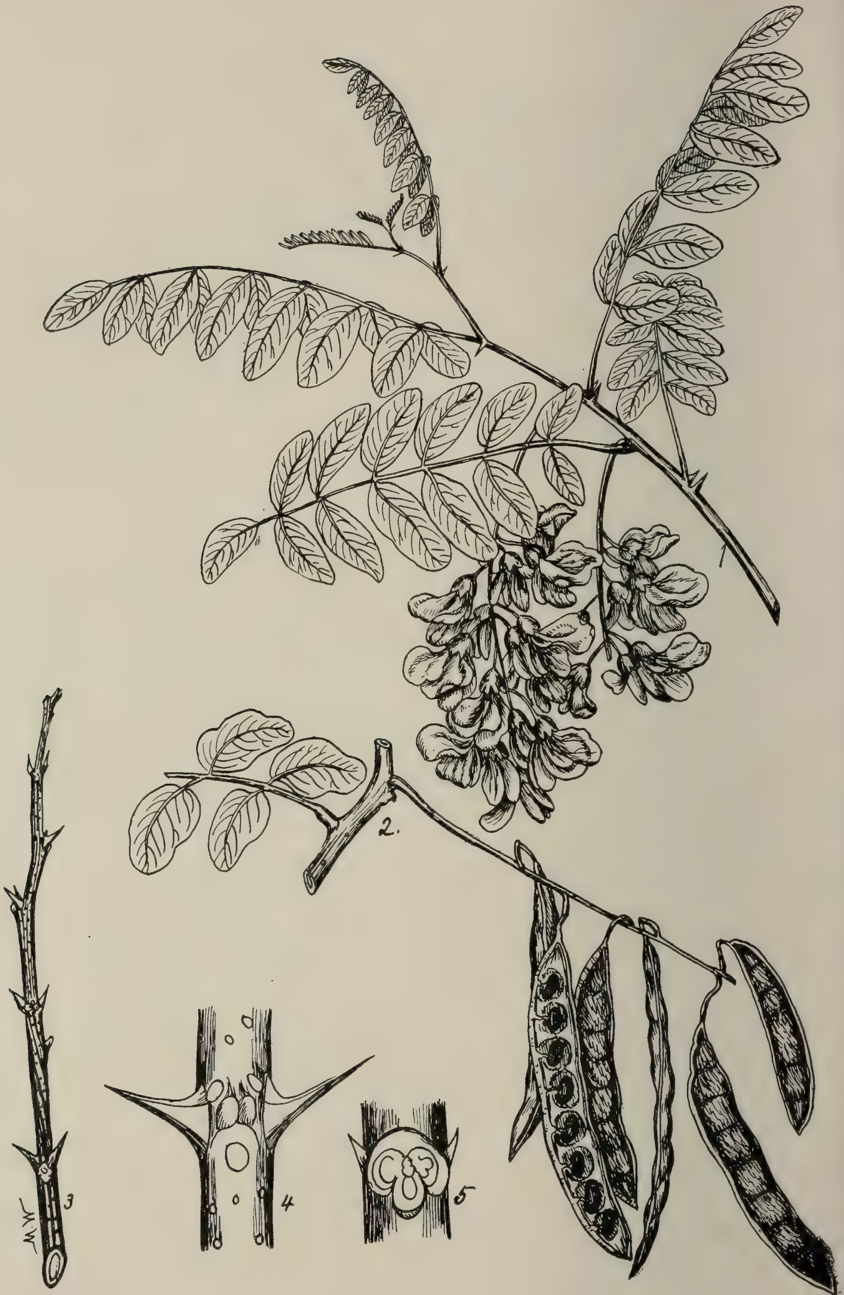

PLATE XCVII. COMMON LOCUST.

1. A flowering branch, x ½.
2. A fruiting branch, x ½.
3. A winter twig, x ½.
4. Section of a winter twig, enlarged.
5. Section of a winter twig, enlarged.

COMMON LOCUST.

Robinia Pseudo-Acacia, Linnaeus.

GENUS DESCRIPTION—This genus comprises 7 species of trees and shrubs native only to North America but some are planted extensively in Europe. Three of the 7 species reach tree-size while the others remain shrubs. The generic name is in commemoration of the French botanist Jean Robin and his son Vespasien.

FORM—A medium-sized tree usually 30-45 ft. high with a diameter of 1-1½ ft. but may reach a height of 75 ft. with a diameter of 2-2½ feet. Forest grown specimens are often straight, clean, and free from branches for ⅔ of height of tree. Open grown specimens usually branch low. Crown usually narrow, oblong, and open.

BARK—On both young and old trunks rough, reddish-brown, deeply furrowed, with high rather rounded ridges which do not peel off in scales; sometimes 1-1½ inches in thickness. See Fig. 83.

TWIGS—Rather stout, brittle, more or less zigzag, round to angular in cross-section, sometimes ridged, greenish to reddish-brown; often bearing two spines at a node, covered with a few pale lenticels; pith white and often angular.

BUDS—Alternate; terminal one absent; small, 3-4 superposed, imbedded in twig under leaf-scar in a rusty somewhat hairy cavity. Their position is hardly visible in winter but becomes evident in spring when growth starts.

LEAVES—Alternate, compound, 8-14 inches long; petioles slender, grooved on top, and swollen at the base. Leaflets odd in number and stalked, ovate to oblong, 7-9 in number, 1-2 inches long, usually rounded at apex and base, entire on margin.

LEAF-SCARS—Alternate, more than 2-ranked, rather large and conspicuous, irregular in outline, covering the buds; often located between two prickles which are developed and hardened stipules; contain 3 bundle-scars.

FLOWERS—Appear about May after the leaves or occasionally before the leaves, resembling the blossom of a pea. Perfect, cream-white, about an inch across, fragrant, borne on slender stalks about ½ of an inch long, arranged in loose drooping racemes 4-5 inches long.

FRUIT—A small, dark brown, and thin pod, 2-4 inches long and ½ of an inch wide; usually containing from 4-8 small dark brown mottled seeds. The pods often persist far into winter.

WOOD—Ring-porous; rays quite distinct especially on radial section; heavy, very hard and strong, very durable in contact with the soil, yellowish-brown to cherry-red or reddish-brown with thin greenish or yellowish sapwood. Weighs about 46 lbs. per cubic foot. Used extensively in former time for ship building, and at present for posts, in turnery, for tree nails, insulator pins and fuel.

DISTINGUISHING CHARACTERISTICS—The Common Locust, also known as the Black Locust, Yellow Locust, White Locust, Locust, and Acacia, may be distinguished by its drooping racemes of white irregular flowers, its odd-pinnate compound leaves, its twigs with two short spines at a node, its 2-4 inches long leathery fruit pod and its deeply furrowed reddish- brown bark. The leaf-scars located between the two spines when present and covering 3-4 rusty downy superposed buds are also charactertistic. The characteristic coloration of the foliage of this tree when attacked by the Locust Leaf Miner and the characteristic swelling of the branches when attacked by the Locust Borer aid in recognizing it. The presence of the fruiting body of the Locust Rot (Fomes rimosus) so common in southern Pennsylvania, is a sure means of identifying the tree.

RANGE—Mountains of Pennsylvania, south to Georgia, westward to Iowa and Kansas. Naturalized over an extensive area in America and widely planted in Europe.

DISTRIBUTION IN PENNSYLVANIA—Originally it was found only in the central and southern portions of the Allegheny Mountains in this State. At present it is found all over the State as an ornamental tree or in fence rows and in many places it has escaped into the forest and abandoned fields.

HABITAT—Grows vigorously on moist fertile soil, especially on rich bottomlands and along mountain streams. Also grows on rather rocky and sterile mountain slopes. Frequent on abandoned charcoal hearths and mud-dams found near ore mines.

IMPORTANCE OF THE SPECIES—The real importance of this tree is somewhat in doubt. It produces excellent wood and grows rapidly in some localities, especially where it is free from enemies. Two insects, known as Locust Borer and Locust Leaf Miner, and a fungus known as the Locust Rot (Fomes rimosus), are doing enormous damage to this tree locally. In regions where these enemies are wanting and where suitable soil and climate are at hand it may be advisable to plant this tree especially when posts, poles, or ties are desired. It has very attractive flowers which may appear before, with, or after the leaves.

THE CASHEW FAMILY—ANACARDIACEAE.

This family contains a large number of small trees and shrubs and a few woody climbers widely distributed over the world, but most abundant in the tropics. Many of the representatives of this family are noted for their acrid, resinous, or milky juice which makes them of considerable value in medicine, tanning, and the manufacture of varnishes and resins.

About 50 genera with 500 species belong to this family. North America has few representatives. Only 3 genera with tree representatives are embraced in its flora. The genus Rhus is the only one native to northeastern America. It has representatives in Pennsylvania.

THE SUMACHS--RHUS, Linnaeus.

The Sumachs comprise a large number of trees and shrubs which are widely distributed. About 120 species are known of which number about 16 species are native to North America and 6 to Pennsylvania. Most of the species of this genus are found in South Africa. All have large pithy twigs and a milky, sometimes poisonous, sticky juice. The leaves of all are alternate. One species alone is evergreen and one other has simple leaves. All others are deciduous and have compound leaves.

Three of the 6 species native to Pennsylvania reach tree-size. The others are mere shrubs. The Poison Ivy or Poison Oak (Rhus Toxicodendron L.) is very abundant along fences and by roadsides. Its stem often trails along the ground and sends up short branchlets which bear the compound leaves with 3 leaflets. The leaves are poisonous to the touch. The Smooth Sumach (Rhus glabra L.) is a low-growing and spreading shrub sometimes becoming a small tree. It has glabrous branchlets which are more or less glaucous. It has compound leaves with 11-31 leaflets. It is very common in abandoned fields and seems to thrive on sandy soil. The Fragrant Sumach (Rhus canadensis Marsh.) reaches a height of 2-6 ft. It has compound leaves with 3 leaflets which are aromatic when crushed. The Smoke-Tree (Rhus Cotinus L.) is one of the commonest plants of our gardens and lawns. It is an introduced species coming from Europe and warm-temperate Asia. Locally it has escaped cultivation.

SUMMER KEY TO THE SPECIES.

Page.

1. Leaf-petioles winged; leaflets with entire margins except near apex, ..**R. copallina** 186
1. Leaf-petioles not winged; leaflets either with entire or serrate margins, ... 2

2. Leaflets 7-13, with entire margins, ...**R. Vernix** 184
2. Leaflets 11-31, with serrate margins, ...3

3. Leaflets glaucous beneath; twigs smooth; shrubs, ...**R. glabra** 182
3. Leaflets not glaucous beneath; twigs densely hairy; small trees, ...**R. typhina** 185

WINTER KEY TO THE SPECIES.

1. Terminal bud present; fruit white, smooth, in loose, drooping, grape-like clusters frequents swamps; leaf-scars broad, do not encircle buds; juice poisonous, ... **R. Vernix** 184
1. Terminal bud absent; fruit red, hairy, in compact erect clusters; frequents dry soils; leaf-scars encircle or almost encircle buds; juice not poisonous, ...2

2. Twigs stout, with watery juice; leaf-scars broadly crescent-shaped, ...**R. copallina** 186
2. Twigs very stout, with milky juice; leaf-scars narrower, ...3

3. Twigs densely hairy, ...**R. typhina** 185
3. Twigs smooth, ...**R. glabra** 182

POISON SUMACH.

Rhus Vernix, Linnaeus.

FORM—A shrub to small tree, usually 5-10 ft. high but may reach a height of 20 ft. with a diameter of 8 inches. Usually branches near ground. Crown wide, deep, and usually rounded.

BARK—Smooth, somewhat streaked, thin, light to dark gray, roughened with horizontally-elongated lenticels.

TWIGS—Stout, orange-brown, later light gray, smooth, often glossy, covered with numerous raised lenticels, contain yellowish-brown pith; if punctured or cut, exude watery juice which turns yellow upon exposure.

BUDS—Alternate; terminal bud present and larger than lateral ones; purplish, conical, acute, about 1/5-3/5 of an inch long, covered with a few scales which are downy on back and margin.

LEAVES—Alternate, compound, 7-14 inches long, with wingless petiole, and with 7-13 leaflets, obovate, 3-4 inches long, acute at apex, wedge-shaped at base, entire-margined, dark green and shiny above, pale below.

LEAF-SCARS—Alternate, large, broad, conspicuous, do not encircle buds, upper margin straight or nearly so, contain numerous bundle-scars which are scattered or arranged in a curved line.

FLOWERS—Appear about June or July. Staminate and pistillate flowers borne on different plants. The small yellowish-green flowers are arranged in long, drooping, rather narrow panicles.

FRUIT—A small, spherical, glossy, ivory-white to yellowish-white drupe arranged in loose, drooping, grape-like clusters. It is about 1/5 of an inch in diameter, slightly compressed and often persists far into winter. Ripens about September. Pistillate trees alone bear fruit.

WOOD—Ring-porous; brittle, soft, coarse-grained, light yellow in color. Weighs 27.31 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Poison Sumach, also known as Poison Oak, Poison Dogwood, Poison Elder, and Swamp Sumach, can be recognized in winter by its alternate buds with the terminal bud present, its broad leaf-scars which do not encircle the bud and its smooth and rather stout branchlets. The white berry-like fruit arranged in drooping clusters often persists far into winter. The leaves are compound, without winged petioles and have from 7-13 shiny leaflets with entire margin which turn to a brilliant scarlet or orange in autumn. This species is usually found in swamps.

RANGE—Ontario, south to Florida, west to Minnesota and Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Occasional and local in the eastern, southern and central parts. Rarer in other parts.

HABITAT—Prefers low grounds and swamps. Occasionally found on moist slopes.

IMPORTANCE OF THE SPECIES—This shrub or small tree is one of our most poisonous plants. The wood which it produces is of no commercial importance. Some people are entirely immune to its poisonous principles, while others are affected by it upon handling it while a few need only to walk by it. It is claimed all traces of the poison can be removed by washing the parts thoroughly with a saturated alcoholic solution of acetate of lead immediately or a few hours after the contact. Pure alcohol is also valuable as a wash if applied shortly after contact.

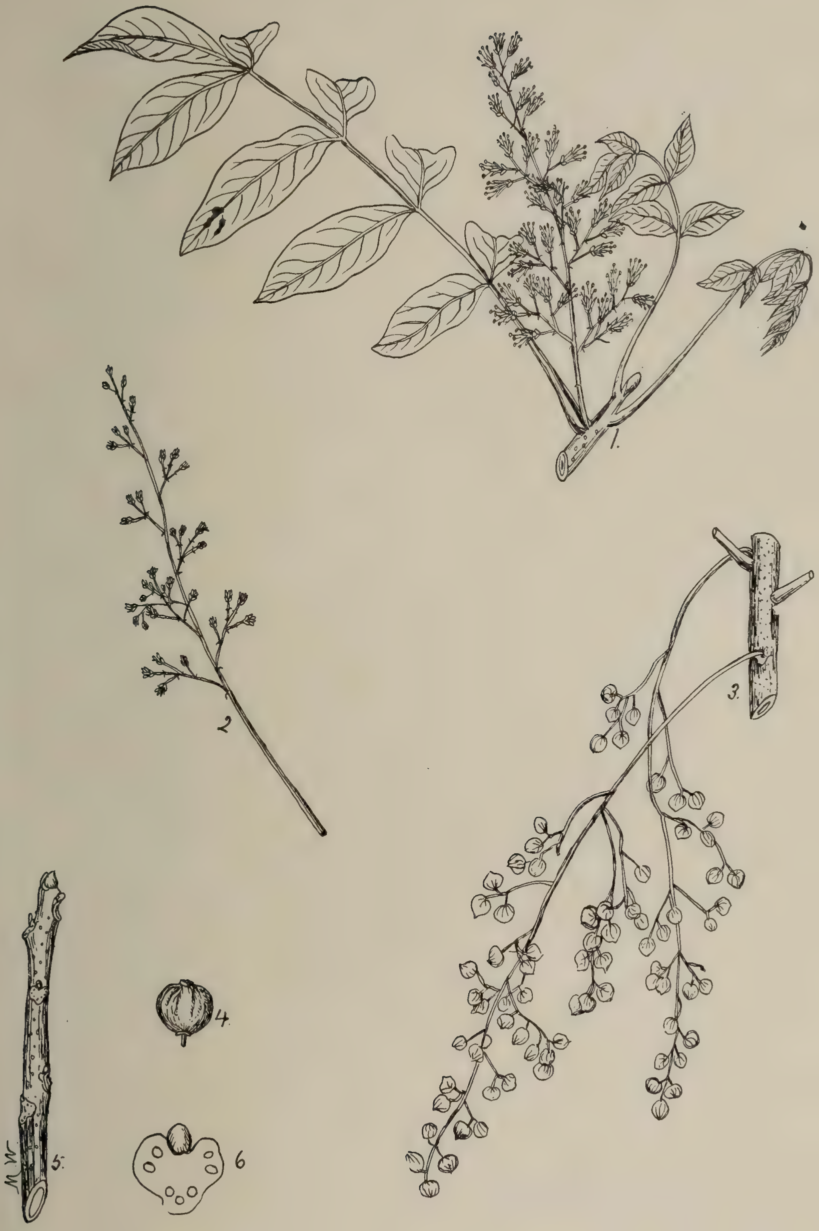

PLATE XCVIII. POISON SUMACH.

1. Branch with immature and mature leaves, and a staminate flower panicle, x ½.
2. A pistillate flower panicle, x ½.
3. A section of a branch with two drooping clusters of fruit, x ½.
4. A single fruit, enlarged.
5. A winter twig, x ½.
6. An axillary bud and a leaf-scar with bundle-scars, enlarged.

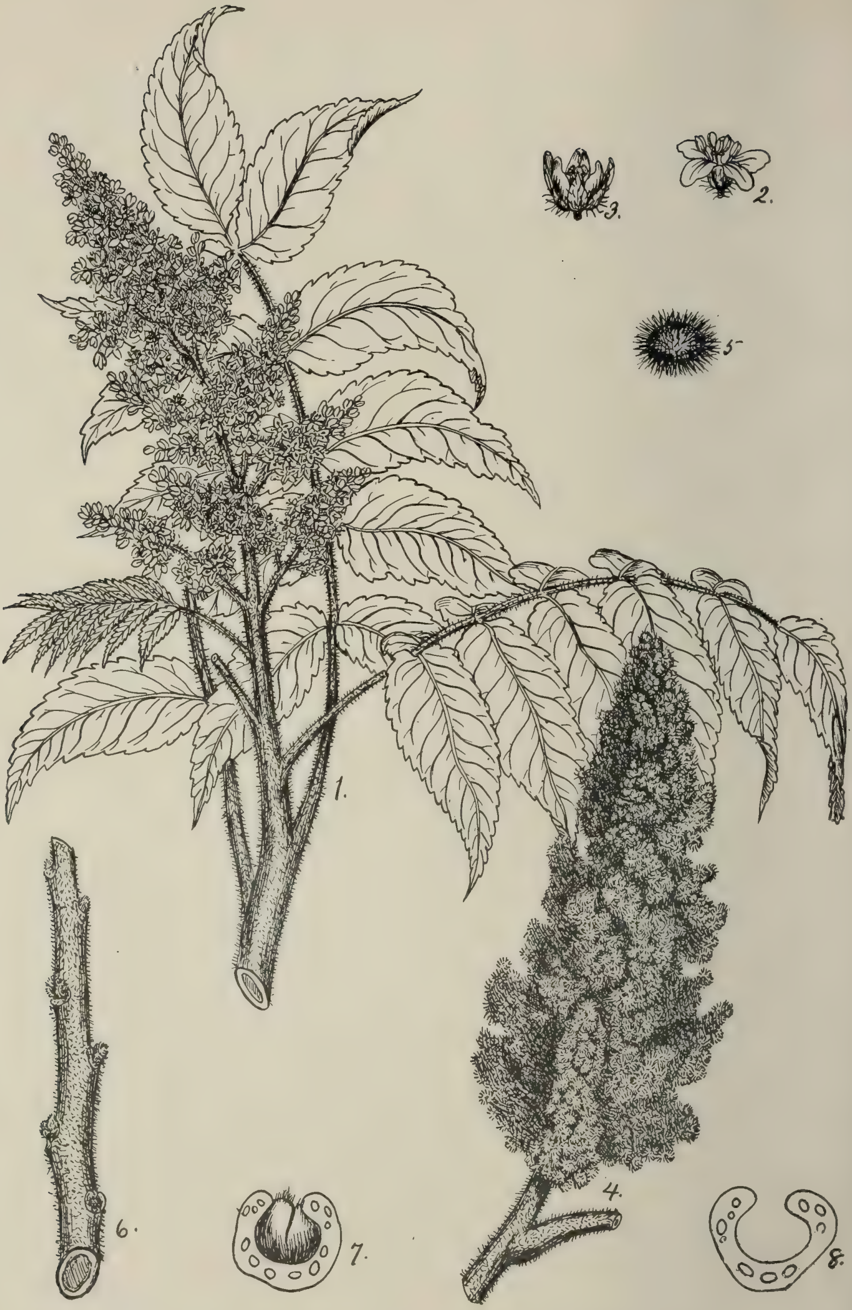

PLATE XCIX. STAGHORN SUMACH.

1. Branch with a flower panicle and mature leaves, x ½.
2. A staminate flower, enlarged.
3. A pistillate flower, enlarged.
4. An erect cone-like fruit cluster, x ½.
5. A single hairy fruit, enlarged.
6. A hairy winter twig, x ½.
7. A bud almost surrounded by a leaf-scar with bundle-scars, enlarged.
8. A leaf-scar, enlarged.

STAGHORN SUMACH.

Rhus typhina, Linnaeus.

FORM—A shrub or small tree usually reaching a height of 10-20 ft. but may reach a height of 40 ft. with a diameter of 15 inches. Trunk usually short, bearing a broad flat-topped crown. Lateral branches are decidedly ascending.

BARK—On old trunks rough, dark brown, sometimes scaly; on younger trunks and branches smooth, thin, somewhat papery, covered with numerous lenticels which later develop into rough dots. Rich in tannin.

TWIGS—Covered for 3 years with brown to black velvety pubescence, later smooth, stout, clumsy; if cut or punctured exude a milky juice, which turns black upon exposure. Twigs are often frozen back in winter, covered with conspicuous orange-colored lenticels, and contain a large yellowish-brown pith.

BUDS—Alternate; terminal bud absent; conical, spherical obtuse, covered with dense rusty hairs.

LEAVES—Alternate, compound, 16-24 inches long, with stout wingless petiole and 11-31 leaflets. Leaflets oblong, 2-5 inches long, nearly sessile, acute at apex, serrate on margin, rounded or heart-shaped at base; when mature smooth, dark green above, and pale beneath.

LEAF-SCARS—Alternate, nearly encircle bud, large, conspicuous, U-shaped, contain scattered bundle-scars sometimes grouped in 3s.

FLOWERS—Appear in May or June. Occur in dense yellowish-green panicles. Staminate panicles are about 8-12 inches long and 5-6 inches broad. Pistillate panicles are only 5-8 inches long but more compact.

FRUIT—Arranged in compact, erect, cone-like, red clusters which are 5-8 inches long, 2-3 inches broad and persist far into winter. Only plants bearing pistillate flowers produce fruit. The single fruit is a spherical drupe covered with red hairs and contains a small hard seed. Sumachs with red fruit are not poisonous.

WOOD—Ring-porous; brittle, soft, orange-colored, streaked with green, rather satiny to touch. Sapwood broad and white. Weighs 27.15 lbs. per cubic foot. Used for manufacture of spiles, cups, napkin rings, and balls for darning stockings.

DISTINGUISHING CHARACTERISTICS—The Staghorn Sumach, also known as Velvet Sumach, can be distinguished from all our native Sumachs by its velvety pubescent twigs. The Smooth Sumach (Rhus glabra L.) is usually smaller and has its twig covered with a bloom, but not with pubescence. The Dwarf Sumach (Rhus copallina) has winged petioles and a watery juice while the Staghorn Sumach has no winged leaf-petioles but has a milky juice. The Poison Sumach has a terminal bud, white drooping fruit, entire leaf-margins, leaf-scars which do not encircle buds, and frequents swamps, while the Staghorn Sumach has no terminal bud, has red and erect fruit clusters, serrate leaf-margins, leaf-scars which almost encircle buds, and frequents dry soils.

RANGE—New Brunswick to Minnesota, and southward to Georgia and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State. Very common in eastern and southern parts. Rarer in northern and western parts.

HABITAT—Usually found on fertile dry upland soil. Rarer on border of swamps and streams. Frequents abandoned fields and fences.

IMPORTANCE OF THE SPECIES—This species is of little commercial importance. The wood is rarely used. The bark of the stem and roots, and the leaves are rich in tannin. It is occasionally planted for ornamental purposes.

DWARF SUMACH.

Rhus copallina, Linnaeus.

FORM—A small shrub rarely more than 6-8 ft. tall, becomes a tree only in Arkansas and Texas.

BARK—Rather thin, light to reddish-brown, often smooth; on older specimens may peel off into papery layers, frequently roughened by large, elevated, brownish projections.

TWIGS—At first hairy, somewhat zigzag and greenish-red; later smooth, reddish-brown, and roughened by prominent leaf-scars and large dark-colored lenticels; frequently roughened by large elevated rugosities.

BUDS—Alternate; terminal bud absent; axillary, small, spherical, covered with rusty brown pubescence.

LEAVES—Alternate, compound, 6-12 inches long, with winged petioles and 9-21 leaflets. Leaflets ovate-lanceolate, acute at apex, often unequal and wedge-shaped at base, entire on margin except near apex where a few serrate teeth may be found, usually smooth above and pubescent below.

LEAF-SCARS—Alternate, broadly crescent-shaped to inversely triangular; partly surround buds; contain a few clusters of bundle-scars often occurring in 3s.

FLOWERS—Appear about July. Produced in axillary or terminal panicels. Staminate and pistillate usually occur on different plants.

FRUIT—Matures about 5-6 weeks after flowers. Usually arranged in dense, stout, pubescent, often persistent, red clusters. The individual fruit is spherical, about ⅛ of an inch across, covered with a hairy red coat and contains a smooth orange-colored seed.

WOOD—Diffuse-porous; soft, coarse-grained, light brown, richly striped with yellow and black. Weight and uses are about the same as the Staghorn Sumach.

DISTINGUISHING CHARACTERISTICS—The Dwarf Sumach, also known as Mountain Sumach can be distinguished from our other native species of Sumach by its winged leaf-petioles and its leaflets which are entire-margined except near the apex. Its branches contain a watery juice while the branches of the Staghorn and Smooth Sumach contain a milky juice. Its branches are smooth while those of the Smooth Sumach are covered with a bloom and those of the Staghorn Sumach with a velvety pubescence. It has neither terminal buds nor white fruit like the Poison Sumach.

RANGE—Maine to Florida, west to Nebraska and Texas.

DISTRIBUTION IN PENNSYLVANIA—Local, often common, throughout the State.

HABITAT—Common on dry hillsides and ridges. Occasional on rich bottomlands. Frequents abandoned fields.

IMPORTANCE OF THE SPECIES—The Dwarf Sumach is merely a shrub east of the Mississippi and consequently of no commercial importance. It may be utilized in landscape gardening on account of its dwarf form and attractive autumnal foliage. It reaches tree-size in Arkansas and Texas.

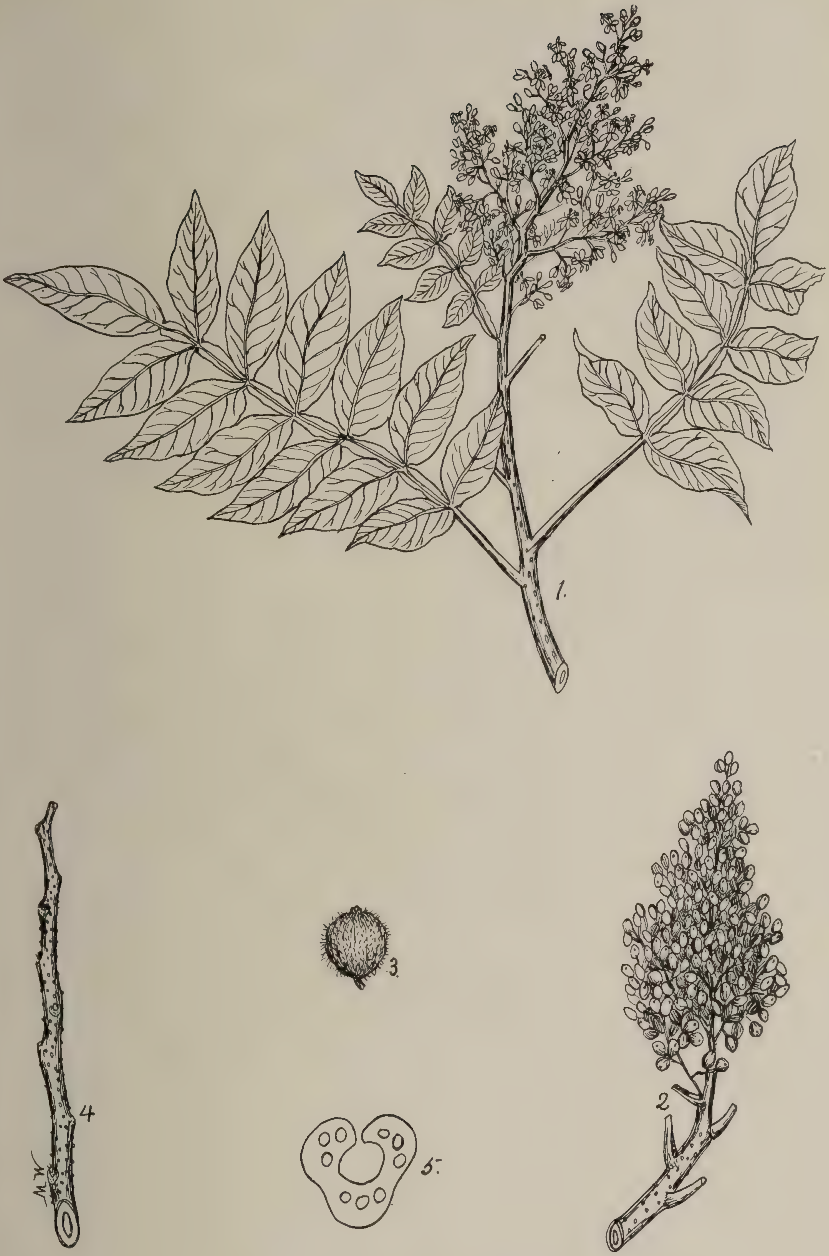

PLATE C. DWARF SUMACH.

1. Branch with mature leaves with winged rachises, and a panicle of flowers, x ½.
2. A branch with an erect cluster of fruit, x ½.
3. A single hairy fruit, enlarged.
4. A winter twig, x ½.
5. A leaf-scar with bundle-scars, enlarged.

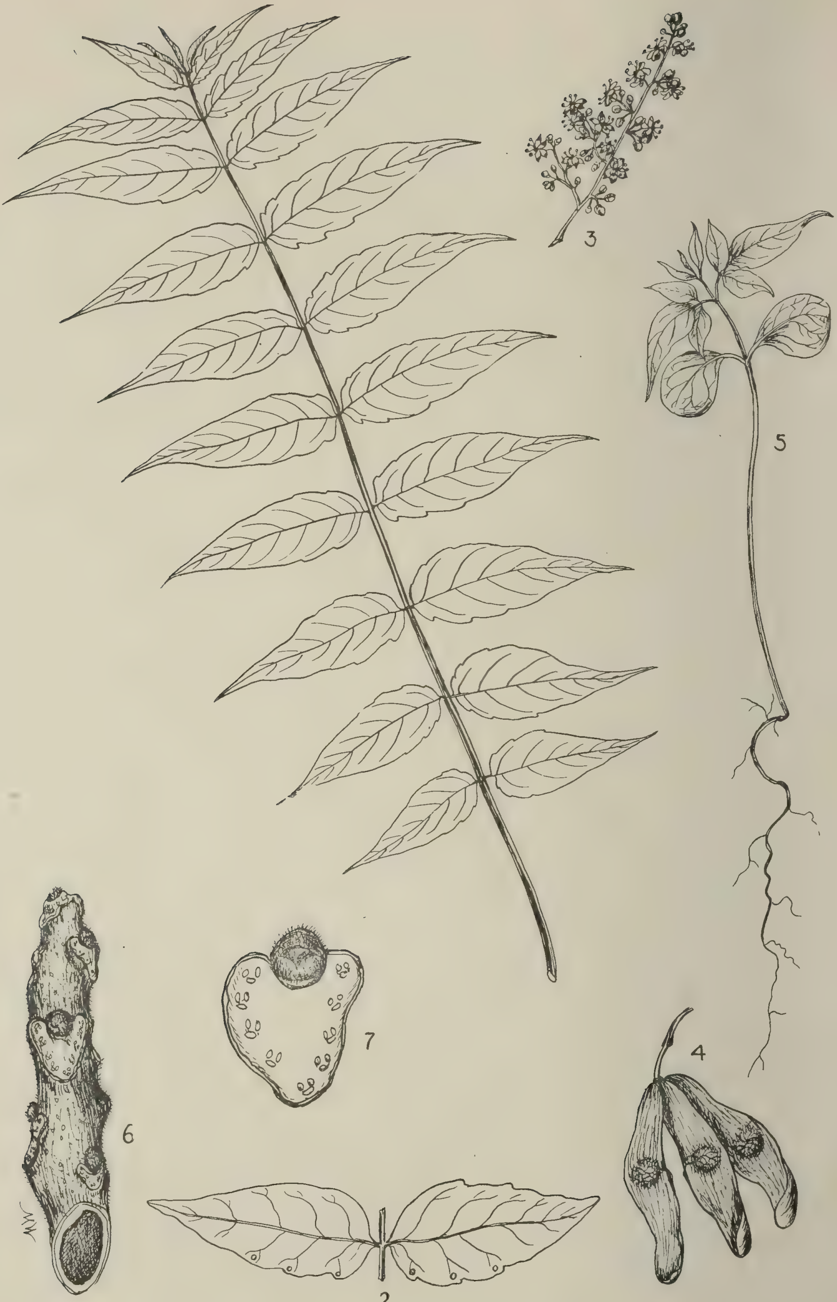

PLATE CI. TREE OF HEAVEN.

1. A mature leaf, x ¼.
2. Lower side of two leaflets showing glands, x ½.
3. A panicle of flowers, x ½.
4. A small cluster of winged seeds, x ½.
5. A seedling, x ½.
6. A winter twig, x ½.
7. A bud and a leaf-scar with bundle-scars, natural size.

TREE OF HEAVEN.

Ailanthus glandulosa, Desfontaines.

FAMILY AND GENUS DESCRIPTION—The Quassia family, Simarubaceae, comprises about 30 genera with 150 species found mostly in the tropics and the warmer parts of both the eastern and western hemispheres. Three genera, each with 1 tree species, are native to the southern part of the United States. A single species of a fourth genus has been introduced from China. This genus, Ailanthus, contains 7 species all native to eastern Asia. No member of this family is native to Pennsylvania.

FORM—May reach a height of 100 ft. with a diameter of 3 ft., but usually much smaller. Trunk usually short, but sometimes long, bearing stout branches with few branchlets. Crown wide, high, and flat-topped.

BARK—On younger trunks smooth, thin, light gray, somewhat roughened with fissures. Ridges usually dark and stand in strong contrast with the light fissures. On old trunks thin, close, roughened with diamond-shaped fissures, dark gray and sometimes black. See Fig. 99.

TWIGS—Stout, clumsy, yellowish-green to reddish-brown, covered with a fine velvety down and numerous, longitudinally-elongated, ochre-colored, scattered lenticels. Pith large, rather hard, light brown. When broken or crushed the twigs give forth a rank smell. Longitudinal striations may appear after outer covering of twigs scales off.

BUDS—Alternate; terminal bud absent; false terminal bud often present; reddish-brown, downy, about 1/8-1/6 of an inch long, located in notch of upper surface of the leaf-scar, covered with scales; the two outer scales do not quite cover the bud, hence they leave a narrow slit running parallel with the twig.

LEAVES—Alternate, compound, 1½-3 ft. long, composed of 11-41 leaflets. Leaflets ovate-lanceolate, 3-5 inches long, acuminate at apex, truncate to heart-shaped at base, almost entire with a few coarse teeth towards the base of the leaf. Glands may be present on the lower side of the leaflets near or on the small basal lobes.

LEAF-SCARS—Alternate, large, conspicuous, more than 2-ranked, heart-shaped, lighter in color than twig, have raised margins and contain about 8-14 conspicuous bundle-scars arranged in a V-shaped line. Bundle-scars sometimes curved or compounded.

FLOWERS—Appear about June when leaves are fully developed. Staminate and pistillate flowers occur on separate trees. Individual flowers small, green, and arranged in terminal panicles. The staminate have a very unpleasant odor.

FRUIT—Borne only on female or pistlilate trees in conspicuous clusters which often persist far into winter. Each fruit consists of a spirally twisted wing about 1½ inches long and ½ of an inch wide, in the center of which a small seed is located.

WOOD—Ring-porous; with conspicuous rays; white to pale yellow, light, soft, weak, and open-grained. Used in cabinet work, for wooden ware, and for charcoal.

DISTINGUISHING CHARACTERISTICS—The Tree of Heaven, also known as Paradise Tree, Ailanthus, Haven-Wood and Chinese Sumach, can be distinguished in winter by its stout twigs which are covered with fine down and conspicuous scattered lenticels, and contain a large light brown pith; twigs are roughened by large heart-shaped leaf-scars containing a curved line of bundle-scars. The small gaping downy buds situate in the notch on the upper surface of the leaf-scars, are also characteristic. In summer the large alternate leaves with 11-41 leaflets which often have glands on the lower surface, are distinctive. The bark cannot be confused with that of any native tree.

RANGE—Native of China. Widely planted in Ontario, Canada and the northeastern United States. Frequently it has escaped cultivation and is found in abandoned fields, in forest borders, and along fences.

DISTRIBUTION IN PENNSYLVANIA—Naturalized extensively in the eastern, southern, central and western parts of the State. Escaped cultivation in many places. Thickets of it are found in Franklin county. In some places it is not only found in the open fields and along fences but is migrating into the forest with the hardwoods and pines.

HABITAT—Tolerates almost any kind of soil and dense shade. Its rapid growth often enables it to dominate over its associates.

IMPORTANCE OF THE SPECIES—This tree is of no special importance as a forest tree and has serious demerits as a shade or park tree. It was introduced into England about 1751 by missionaries and from there it was soon brought to America and first planted near Philadelphia. At first it was a very popular tree, but it soon lost favor. The staminate flowers are very ill smelling. The wood is inferior in quality. The rapid and free growth of the root sprouts makes it almost impossible to eradicate it when once established. Its aggressive migration into fields and forest is undesirable.

AMERICAN HOLLY.

Ilex opaca, Ait.

FAMILY AND GENUS DESCRIPTION—The Holly family, Aquifoliaceae, comprises 3 genera with about 290 species of small trees and shrubs distributed in temperate and tropical regions. Two genera, Ilex and Nemopanthus, are native to Pennsylvania. The former genus is represented by 5 species and the latter by 1 species. Two of the 5 species of the genus Ilex are described below. The Mountain Holly, Nemopanthus mucronata, is usually a shrub rarely over 10 ft. in height.

FORM—Usually a small tree reaching a height of 15-30 ft., but may attain a height of 50 ft. with a diameter of 3 feet. It is small in the North, but becomes larger in the South. Trunk short and bears slender, spreading and ascending branches which form a conic crown.

BARK—Close, white or grayish or yellowish-brown, up to ½ of an inch in thickness, becoming rough with age.

TWIGS—Rather slender finely rusty hairy but soon become smooth and light brown, covered by a few inconspicuous lenticels.

BUDS—Alternate; terminal one present and pointed; lateral ones are short, blunt-pointed, and somewhat downy.

LEAVES—Alternate, simple, evergreen, thick, mostly smooth, flat, oval, with wavy margin and spiny teeth. Petioles are short, stout, and often hardy. Midrib is very prominent on the lower surface of the leaf.

LEAF-SCARS—Alternate, semi-oval, rather conspicuous, with raised margin containing solitary bundle-scars.

FLOWERS—Appear from April to June. The staminate and pistillate usually occur on different trees. The staminate are 2-9 on a common stalk while the pistillate are usually solitary.

FRUIT—A bright red drupe, about the size of a pea, smooth, shining, persisting far into winter; containing a light brown nutlet with usually 4 ribs.

WOOD—Diffuse-porous; with distinct and colorless medullary rays; chalky-white in color, medium in weight, hard, tough, not strong, close-grained. Weighs 36.26 lbs. per cubic foot. Used in turnery, cabinet making and interior finishings, and for keys in pianos and organs.

DISTINGUISHING CHARACTERISTICS—The American Holly, also known as Holly or White Holly, can be distinguished at any season of the year by its unique leaves, which are thick, flat, and oval, have wavy margins with scattered spiny teeth and persist for 2 or more years. Branches, bearing these unique leaves, are sold extensively about Christmas in most of our northern markets. The small red fruit, often persisting far into winter, is also distinctive. In cultivation one often finds the closely related European Holly (Ilex Aquifolium) which has leaves of a deeper green and with more wavy margins which have translucent edges. The berries of the European species are deeper red in color.

RANGE—Maine, through Pennsylvania to Florida, westward to Indiana, Missouri and Texas.

DISTRIBUTION IN PENNSYLVANIA—Very rare and local. Found in the following counties: Bucks, Dauphin, Delaware, Chester, Franklin, Lancaster and York. Only one specimen is known to grow wild in Franklin county.

HABITAT—Usually found in moist soil near water. Prefers shelterd and shaded situations.

IMPORTANCE OF THE SPECIES—The American Holly does not produce any wood of commercial importance in this State. Immense quantities of branches, bearing the unique and attractive leaves and bright red berries, are used for decorative purposes during the Christmas season. It is occasionally planted for ornamental purposes because it is very beautiful, but one should remember that it grows slowly.

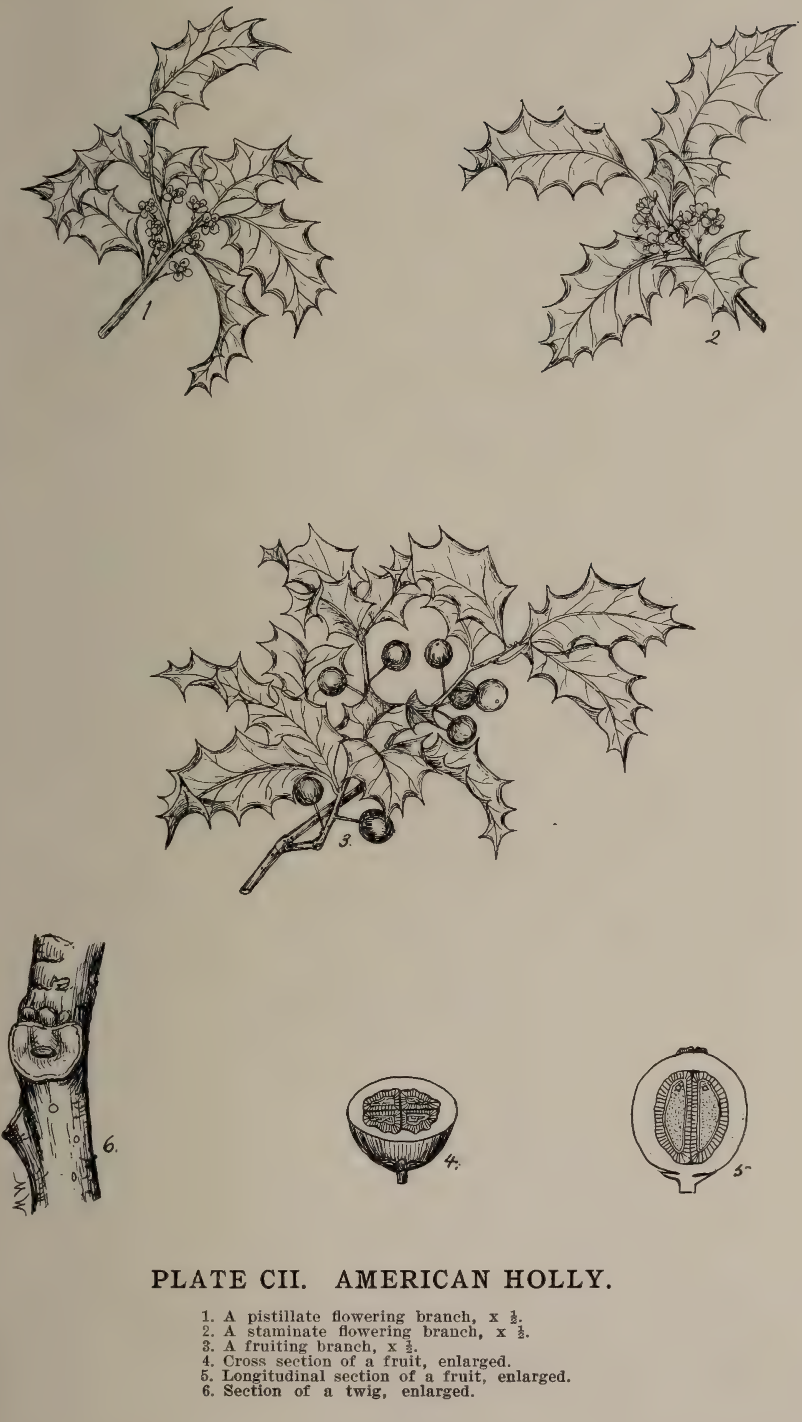

PLATE CII. AMERICAN HOLLY.

1. A pistillate flowering branch, x $\frac{1}{2}$.
2. A staminate flowering branch, x $\frac{1}{2}$.
3. A fruiting branch, x $\frac{1}{2}$.
4. Cross section of a fruit, enlarged.
5. Longitudinal section of a fruit, enlarged.
6. Section of a twig, enlarged.

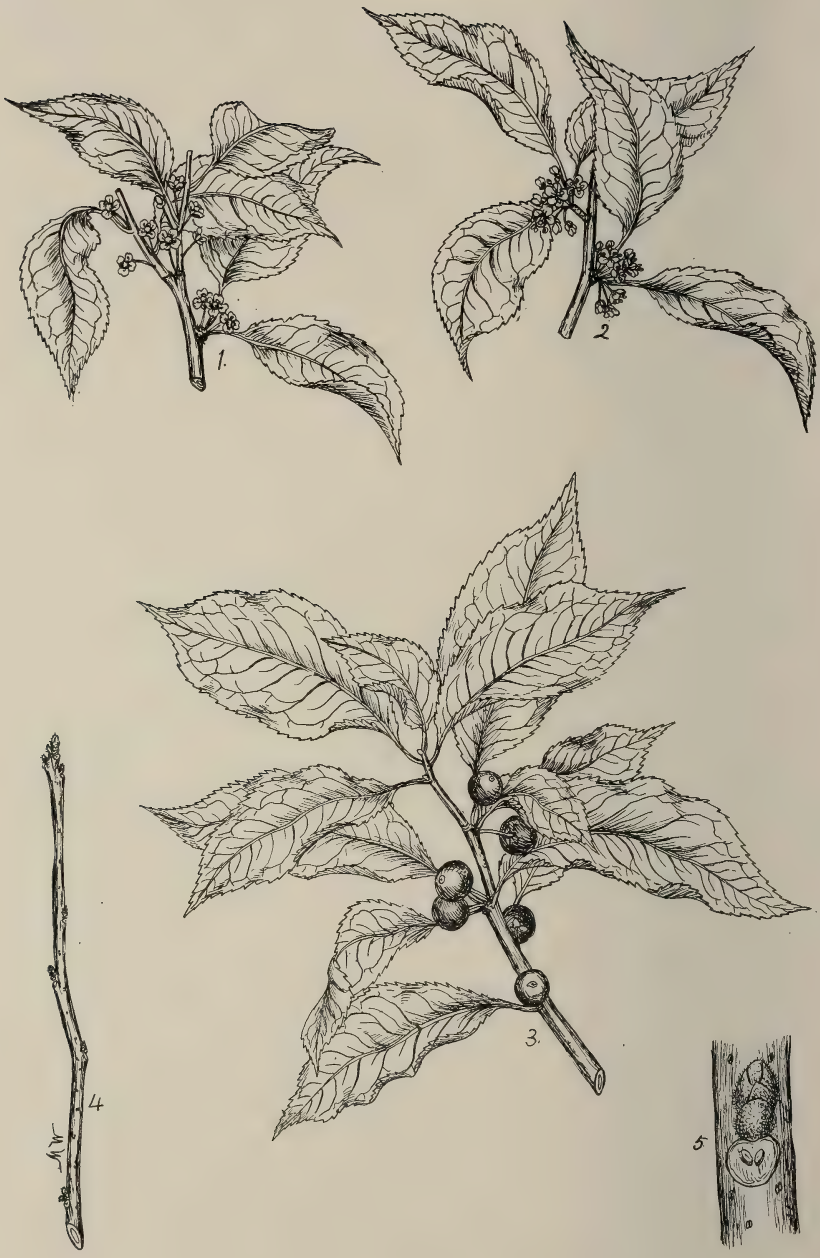

PLATE CIII. LARGE-LEAVED HOLLY.

1. A pistillate flowering branch, x ½.
2. A staminate flowering branch, x ½.
3. A fruiting branch, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.

LARGE-LEAVED HOLLY.

Ilex monticola, Gray.

FORM—A shrub or small tree usually less than 20 ft. in height but may reach a height of 40 ft. with a diameter of 12 inches. It reaches its largest size in North and in South Carolina. Trunk short, bearing a rather wide and deep crown formed by slender, spreading, ascending branches.

BARK—Thin, light brown, rough, warty, covered with numerous lenticels.

TWIGS—Smooth, reddish-brown, becoming dark gray, enlarged at nodes; with decurrent ridges running down from leaf-scars; round, marked by many small lenticels at first indistinct but later conspicuous. Pith round, narrow, light yellowish-green.

BUDS—Alternate, terminal bud present; lateral buds often superposed and covered with gaping scales; broadly ovate to globular, small, about ⅛ of an inch long, sharp-pointed or occasionally blunt-pointed. Bud-scales ovate, keeled, sharp-pointed, light brown, finely hairy at apex.

LEAVES—Alternate, simple, deciduous, 4-5 inches long, ½-2 inches wide, ovate or lanceolate-oblong, taper-pointed at apex, sharply serrate on margin, tapering or rounded at base, thin, smooth, dark green above, paler below.

LEAF-SCARS—Alternate, elliptical to broadly triangular, very small, inclined to twig. Bundle-scars solitary, lunate to almost circular.

FLOWERS—Appear on short lateral stalks about June, when the leaves are almost developed; white or nearly so, small, about ⅓ of an inch across. Staminate clustered, borne upon pedicels about 2/5 of an inch long; pistillate solitary or few in a cluster, on very short pedicels.

FRUIT—Matures about September. Bright scarlet, globose, about 2/5 of an inch in diameter containing 4-6 nutlets; nutlets narrowed at the ends, striate, prominently many-ribbed on the back.

WOOD—Diffuse-porous; hard close-grained, nearly white. In general resembles that of the American Holly, page 188. Weighs about 41 lbs. per cubic foot. Not found on the market.

DISTINGUISHING CHARACTERISTICS—The Mountain Holly may be distinguished by its small size, its small clustered white flowers, its bright scarlet globose clustered fruit with striate many-ribbed nutlets, its ovate or lanceolate-oblong, smooth, sharply-serrate, dark green deciduous leaves, its small leaf-scars with a solitary bundle-scar, and its bitter reddish-brown twigs marked by many small lenticels and decurrent ridges below the leaf-scars. The closely related Black Alder or Winterberry (Ilex verticillata) has many characteristics in common with this species but may be distinguished by its smooth and even nutlets, its flowers which are all short-stalked, its leaves which are more downy on the lower surface.

RANGE—New York to Georgia and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Rather common in the mountainous parts of the State. Rare or absent in other parts.

HABITAT—Usually found in mountain woods. Prefers rich, moist, often rocky situations. Frequently occurs in shaded places under a dense canopy of larger trees.

IMPORTANCE OF THE SPECIES—This tree is of little forestal importance. It remains small, grows slowly and occurs scattered or in small clumps. Its bright foliage and brilliant fruit recommend it for ornamental purposes. It reaches tree-size only in the South.

THE MAPLE FAMILY—ACERACEAE.

The Maple family comprises in addition to the Asiatic genus Dipteronia, with only 1 species, about 70 species, all of which are included in the genus Acer, and distributed with a few exceptions in the northern hemisphere. This family consists mainly of trees and a few shrubs. The members of this family are used more than those of any other family as ornamental and shade trees. Further characteristics of the family are included in the description of the sole American genus which follows.

THE MAPLES—ACER, (Tourn.) L.

This genus comprises approximately 70 species in the world, with 13 species in the United States and 6 species in Pennsylvania. A few exotic species have been introduced exclusively for ornamental and shade purposes. The commonest exotic species are the Norway Maple (Acer platanoides L.) and the Sycamore Maple (Acer Pseudoplatanus L.). On account of their abundance and wide distribution in this State, a descriptive page, together with an accompanying plate, has been devoted to these two species.

The leaves of the Maples are opposite, usually simple or in a few species compound with 3-5 leaflets, and are shed in the autumn. The flowers are regular or polygamous, rarely perfect, and appear before, with or after the leaves. The time at which the flowers appear aids considerably in distinguishing the various species from each other. Some trees bear only staminate flowers, while others bear only pistillate, with the result that one may occasionally find a mature tree which does not produce any fruit. The flowers are pollinated by insects, which are attracted in hordes by the aromatic pollen-bearing blossoms. The fruit is composed of a pair of winged seeds joined together to form the well-known maple key or samara, which matures in early or late summer, depending upon the species. The fruit which matures in early summer germinates at once, while that which matures in late summer remains dormant over winter and germinates the following spring. Wind is the chief agent which disseminates the seeds.

The Maples are separated into two classes with reference to their commercial value, Hard Maple and Soft Maple. This classification is based upon the physical characteristics of the wood. The wood of the Maple is diffuse-porous with rather small medullary rays, usually fine-grained, dense, and in some species hard and beautifully curled and figured, which makes it especially prized for interior finish and cabinet work. Most species yield a saccharine sap which may be concentrated into maple syrup or maple sugar.

Within a family one may often find a wide variation of plant organs, but the genus Acer possibly presents a wider range or a greater variation in its organs than any other genus of trees found in this State. The leaves may be simple or compound, large or small, smooth or hairy. The twigs may be green, brown, or red. The flowers may be in small lateral clusters, in long terminal racemes, or in drooping clusters; appear before, with, or after the leaves. Their color may be green, yellow, or red. The fruit, while similar in all the species so far as type is concerned, varies considerably in size, divergence of the wing, and arrangement. Their habitat also varies, some like the Red Maple, preferring moist locations, while the Mountain Maple frequents rocky situations. In addition to these general differences among the species, a greater difference becomes evident as one studies the detailed description of the species which follow:

SUMMER KEY TO THE SPECIES.

Page.

1. Leaves simple, ...2
1. Leaves pinnately compound, ...A. Negundo 197

2. Leaf petioles with acrid milky sap, ...A. platanoides 198
2. Leaf petioles without acrid milky sap, ...3

3. Flowers in terminal racemes, ...4
3. Flowers in lateral clusters, appearing before or with the leaves 6

4. Flowers appear with the leaves, ...A. Pseudo-platanus 198
4. Flowers appear after the leaves, ...5

5. Flowers in erect racemes; leaves coarsely serrate and usually 3-lobed,....A. spicatum 193
5. Flowers in drooping racemes; leaves finely serrate, 3-lobed at apex, at first brown pubescent beneath, ...A. pennsylvanicum 192

6. Flowers opening before the leaves,, the drooping fruit ripening in spring or early summer, ...7
6. Flowers opening with the leaves, drooping fruit ripening in summer or early autumn, ...A. saccharum 194

7. Flowers with petals; leaves bright green above, pale green nearly glabrous beneath 3-5-lobed; fruit keys incurved, ... A. rubrum 196
7. Flowers without petals; leaves green above whitish or silvery beneath, deeply 5-lobed; fruit keys divergent, ...A. saccharinum 195

WINTER KEY TO THE SPECIES.

1. Buds stalked with few exposed scales, ...2
1. Buds sessile or nearly so, with 6 or more exposed scales, ...4

2. Buds evidently-stalked; bark streaked longitudinally with white lines, ... A. pennsylvanicum 192
2. Buds short-stalked; bark not streaked longitudinally with white lines, ...3

3. Buds small, 1/5 of an inch long including stalk; twigs reddish-brown to dingy gray; pith brown, ...A. spicatum 193
3. Buds large, ovoid, the terminal one acute the lateral obtuse and closely appressed; twigs greenish-purple and glaucous; pith light, ...A. Negundo 197

4. Buds with 8-16 exposed scales, brown, acute, non-collateral, leaf-scars nearly encircle stem, ...A. saccharum 194
4. Buds with 6-8 exposed scales, red or green, obtuse, ...5

5 Terminal buds small, generally less than 1/5 of an inch long; terminal and lateral buds of same size; collateral buds present, ...6
5. Terminal buds large, generally over 1/5 of an inch long; terminal buds larger than lateral; collateral buds absent, ...7

6. Twigs red and lustrous; bark rough but not flaking in large pieces, ...A. rubrum 196
6. Twigs bright chestnut-brown; bark falling away in thin large flakes, A. saccharinum 195

7. Buds red; leaf-scars encircle stem; lenticels scattered; lateral buds appressed; bark black, fissured, not scaly, ...A. platanoides 198
7. Buds green; leaf-scars do not encircle stem; lenticels numerous; lateral buds projecting; bark brownish and scaly, ...A. Pseudo-platanus 198

STRIPED MAPLE.

Acer pennsylvanicum, Linnaeus.

FORM—Usually from 10-25 ft. in height with a diameter of about 6-12 inches, but may attain a height of 40 feet. Trunk usually short dividing into slender and straight branches which form a deep and broad crown.

BARK—Thin, rather smooth, greenish or reddish-brown, conspicuously marked with longitudinal white streaks; later becomes rougher, darker, and less streaked. See Fig. 63.

TWIGS—Smooth, stout, at first greenish, later red, with very few inconspicuous lenticels, and brown pith. Season's growth marked by 2 or sometimes 3 dark lines encircling the twig, formed by fallen outer bud-scales. White longitudinal streaks appear the second season.

BUDS—Opposite, evidently-stalked, large, about 2/5 of an inch long excluding stalk, tapering but blunt-pointed, red, glossy, angular, covered by a single pair of red, smooth, valvate scales enclosing a few pairs of smaller and lighter scales. Outer scales are smooth on surface with ciliate margins while the inner scales are hairy as shown in opposite plate. Terminal buds are large while lateral buds are smaller and closely appressed.

LEAVES—Opposite, simple, goose-foot-like, 3-lobed at apex, finely serrate on margin, rounded at base, rusty-pubescent below. Petioles long, grooved, with enlarged bases.

LEAF-SCARS—Opposite, broadly U-shaped, nearly encircle stem; adjacent edges form rather blunt teeth which are separated by a ridge. Bundle-scars usually 3, often subdivided into 5-8.

FLOWERS—Appear in May or June after the leaves are full grown in drooping terminal racemes. Staminate and pistillate flowers occur on same plant but in different clusters.

FRUIT—Matures in September in drooping racemes; wings of the keys, thin, very divergent, about ¾ of an inch long, marked on one side of seed with a depression.

WOOD—Diffuse-porous; soft, close-grained, light brown with wide zone of sapwood. Seldom used commercially. Weighs 33.02 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Striped Maple, also known as Moosewood and Whistlewood, can be readily distinguished at all seasons of the year by the light longitudinal streaks on the branches and trunk. They often appear the second year and persist for many years on the trunk. In winter the large, evidently-stalked, valvate, and red buds together with the smooth branches and brown pith are characteristic. In summer the drooping raceme of flowers and the goose-foot-like leaves with their finely serrate margins and rusty pubescence on the lower surface are distinctive.

RANGE—From Nova Scotia west to Minnesota, south especially along the mountains to Georgia.

DISTRIBUTION IN PENNSYLVANIA—Rather common locally in the mountainous parts of the State especially on shaded slopes and in deep ravines. Very common in Mifflin, Centre, Blair, and Huntingdon counties.

HABITAT—It prefers moist, cool, shaded, often rocky mountain slopes.

IMPORTANCE OF THE SPECIES—The wood is of practically no commercial value. The chief value of the tree is its attractive ornamental qualities both as an individual tree and as a component of the understory of the forest structure.

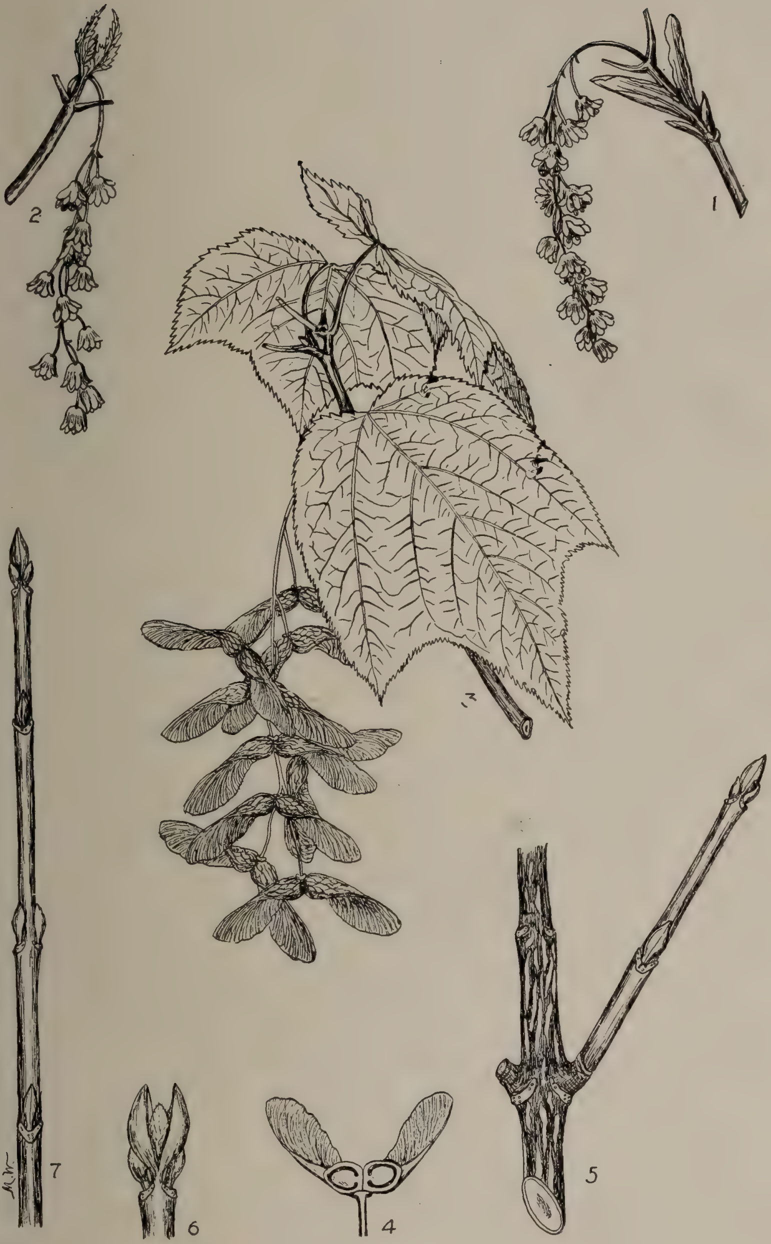

PLATE CIV. STRIPED MAPLE.

1. Branch with drooping raceme of staminate flowers, x ½.
2. Branch with drooping raceme of pistillate flowers, x ½.
3. Branch with mature leaves and drooping raceme of fruit, x ½.
4. A maple key with exposed seeds, x ½.
5. Section of winter branch showing striped bark, buds, and leaf-scars, x ½.
6. Terminal section of winter twig showing evidently stalked buds with outer pair of bud scales separated, exposing the pubescent inner scales, natural size.
7. Section of winter twig showing opposite and stalked buds, and leaf-scars with bundle-scars, x ½.

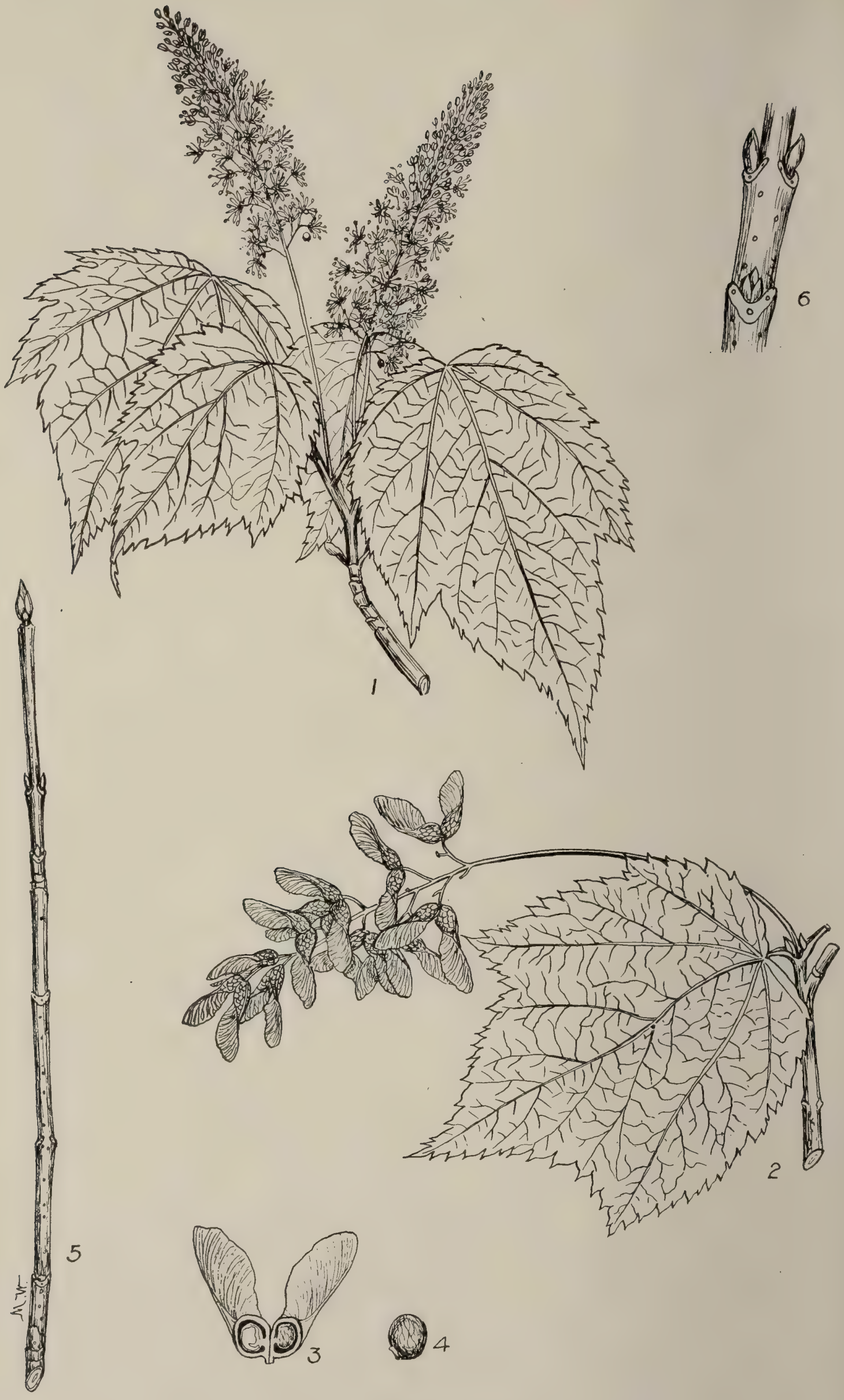

PLATE CV. MOUNTAIN MAPLE.

1. Branch with **mature leaves and two erect racemes of flowers, x ½.**
2. Branch with a mature leaf and a raceme of fruit, **x ½.**
3. A maple **key with exposed seeds, x ½.**
4. A seed, slightly enlarged.
5. Winter twig with stalked buds, lenticels **and** leaf-scars with bundle-scars, x ½.
6. Section of a winter twig, enlarged.

MOUNTAIN MAPLE.

Acer spicatum, Lambert.

FORM—A shrub or small tree sometimes attaining height of 35 ft. with a diameter of 11 inches. Usually a shrub growing in clumps on rocky soil. Trunk usually short and bears rather straight, slender and upright branches.

BARK—Thin, rather smooth, brown or grayish-brown mottled with dingy-gray blotches.

TWIGS—Slightly hairy, at first reddish-purple on exposed side and yellowish-green on shaded side, later bright red and then changing to grayish-brown, covered with few scattered lenticels; contain brown pith, and are encircled by 2 or 3 dark rings formed by the scars of fallen bud-scales.

BUDS—Opposite, short-stalked, rather small, about ¼ of an inch long including stalk; terminal bud larger and more acute-pointed than lateral appressed buds; one pair or sometimes two pairs of more or less hairy, grayish or greenish scales visible.

LEAVES—Opposite, simple, 3-5-lobed, coarsely serrate on margin, cordate at base, somewhat hairy on lower surface. Petioles long, slender, and enlarged at base.

LEAF-SCARS—Opposite, V-shaped, hollow, with 3 bundle-scars, and nearly encircle stem.

FLOWERS—Appear about June after the leaves are full grown, in erect terminal racemes. Staminate flowers occur usually at the top and the pistillate at the base of the raceme.

FRUIT—Matures in September in drooping racemes; wings of the keys somewhat divergent, about ½ of an inch long, the seed-bearing part strongly striated.

WOOD—Diffuse-porous; soft, close-grained, light to reddish-brown with wide zone of light sapwood. Seldom used commercially. Weighs 33.22 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Mountain Maple is essentially a shrubby species growing in small clumps, and can be distinguished from most species of Maple by its stalked, few-scaled winter buds, erect raceme of flowers, hairy-purplish to greenish twigs, and simple, 3-5 lobed coarsely serrate leaves. It differs from the closely related Striped Maple in the absence of light-striped bark and brown pubescence on the lower sides of the leaves, and in the presence of pubescence on the branches, and smaller often gaping buds.

RANGE—Newfoundland to Manitoba, south to Michigan, Pennsylvania, and along the mountains to Georgia.

DISTRIBUTION IN PENNSYLVANIA—Found locally in all parts of the State. Rather common in the mountainous parts.

HABITAT—It prefers moist rocky hillsides. Commonly found bordering ravines. It demands the shade of other species. Very thrifty on the moist slopes and tops of the southern Appalachian Mountains.

IMPORTANCE OF THE SPECIES—It is of practically no commercial importance as a timber tree, but is valuable as a soil protector on rock slopes where a protection forest is desirable. This species is planted very extensively for ornamental purposes.

SUGAR MAPLE.

Acer saccharum, Marshall.

FORM—A large timber tree attaining a maximum height of 120 ft. with a diameter of 5 feet. Open grown trees have short trunks bearing stout, rather erect branches which form a spreading, egg-shaped, often round-topped crown. Trees in closed stands have long, straight, clean trunks bearing shallow, round crowns with large limbs.

BARK—On branches and young trunks smooth and light brown; on older trunks brown, deeply channelled into long irregular plates or flakes which often loosen vertically along the side. See Fig. 62.

TWIGS—Slender, smooth, reddish-brown to orange-brown, covered with numerous pale lenticels.

BUDS—Opposite, brown, sharp-pointed, conical, hairy at apex; terminal bud about twice as long as appressed lateral ones; covered by overlapping scales, with from 8-16 of them exposed.

LEAVES—Opposite, simple, usually 5-lobed, with a sparsely toothed margin and round-based sinuses, cordate at base, thin in texture, 3-5 inches long and greater in width. Mature leaves are bright green above and pale green below.

LEAF-SCARS—Opposite, V-shaped to U-shaped, nearly encircling stem. Bundle-scars usually 3, in a lunate line.

FLOWERS—Appear in April and May with the leaves, in drooping corymbs both from the terminal mixed buds and the lateral propagative buds. The staminate and pistillate occur in different clusters.

FRUIT—Matures about September; clustered, borne on drooping stalks; wings of the keys about ½-1 inch long, parallel, or slightly divergent.

WOOD—Diffuse-porous; heavy, hard, close-grained, with fine surface, light brown to reddish. Used for interior finish, furniture, shoe lasts, railroad ties. Abnormal modifications of the structure of the wood known as Curly Maple and Bird's Eye Maple are rather common and especially prized in cabinet making. Weighs 43.08 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Sugar Maple, also known as Hard Maple and Rock Maple, can be distinguished in summer from the other Maples by its large, simple leaves which are thin in texture and have their lobes coarsely toothed. The flowers appear with the leaves while those of the Red Maple and the Silver Maple appear before, and those of the Mountain Maple and the Striped Maple after the leaves. The fruit clusters of the Sugar Maple are usually developed from terminal buds while those of the Red Maple and Silver Maple are developed from lateral buds. The fruit of the Sugar Maple does not mature until September and may often persist into the winter while the fruit of the Red Maple and Silver Maple matures in early summer and germinates at once after falling upon the ground. In winter the Sugar Maple can be recognized by its conical, sharp-pointed, brown buds with from 8-16 exposed and overlapping scales, and by the slender brown twigs marked with pale lenticels. The rough furrowed trunk is also characteristic of older trees.

RANGE—Newfoundland to Manitoba, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common, especially in the northern and eastern parts of the State. It is possibly, next to Chestnut, the commonest tree in this State.

HABITAT—It flourishes best on well drained rich soil, but will thrive even when the soil is not rich. It is common on low ridges at the base of mountains, and along slopes. It reaches its best development in central New England, New York, northern Pennsylvania, and the Lake States.

IMPORTANCE OF THE SPECIES—The Sugar Maple is a valuable timber tree. Its importance is being realized more as its wood finds new uses. The process of timber impregnation has raised the value of the wood of this species. It is not only valuable as a timber tree but produces annually a large quantity of maple sugar and maple syrup, and in addition is one of our most attractive ornamental trees.

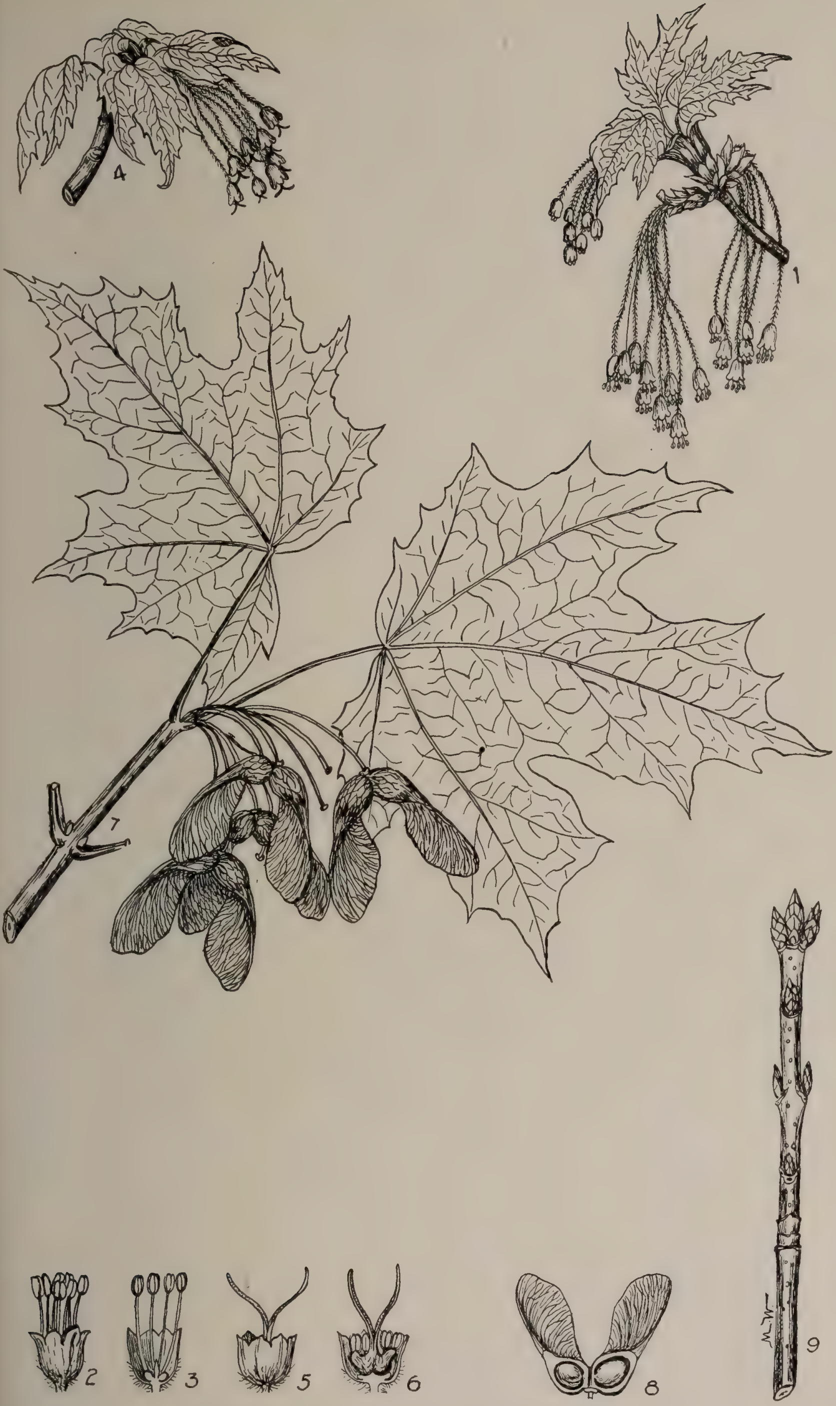

PLATE CVI. SUGAR MAPLE.

1. Branch with immature leaves and staminate blossoms, x ½.
2. Staminate flower with calyx, enlarged.
3. Longitudinal section of staminate flower, enlarged.
4. Branch with immature leaves and pistillate blossoms, x ½.
5. Pistillate flower with calyx, enlarged.
6. Longitudinal section of flower with both a pistil and stamens, enlarged.
7. Branch with mature leaves and cluster of fruit, x ½.
8. A maple key with exposed seeds, x ½.
9. Winter twig showing lenticels, leaf-scars, bud-scale scars, and sharp-pointed opposite buds, x ½.

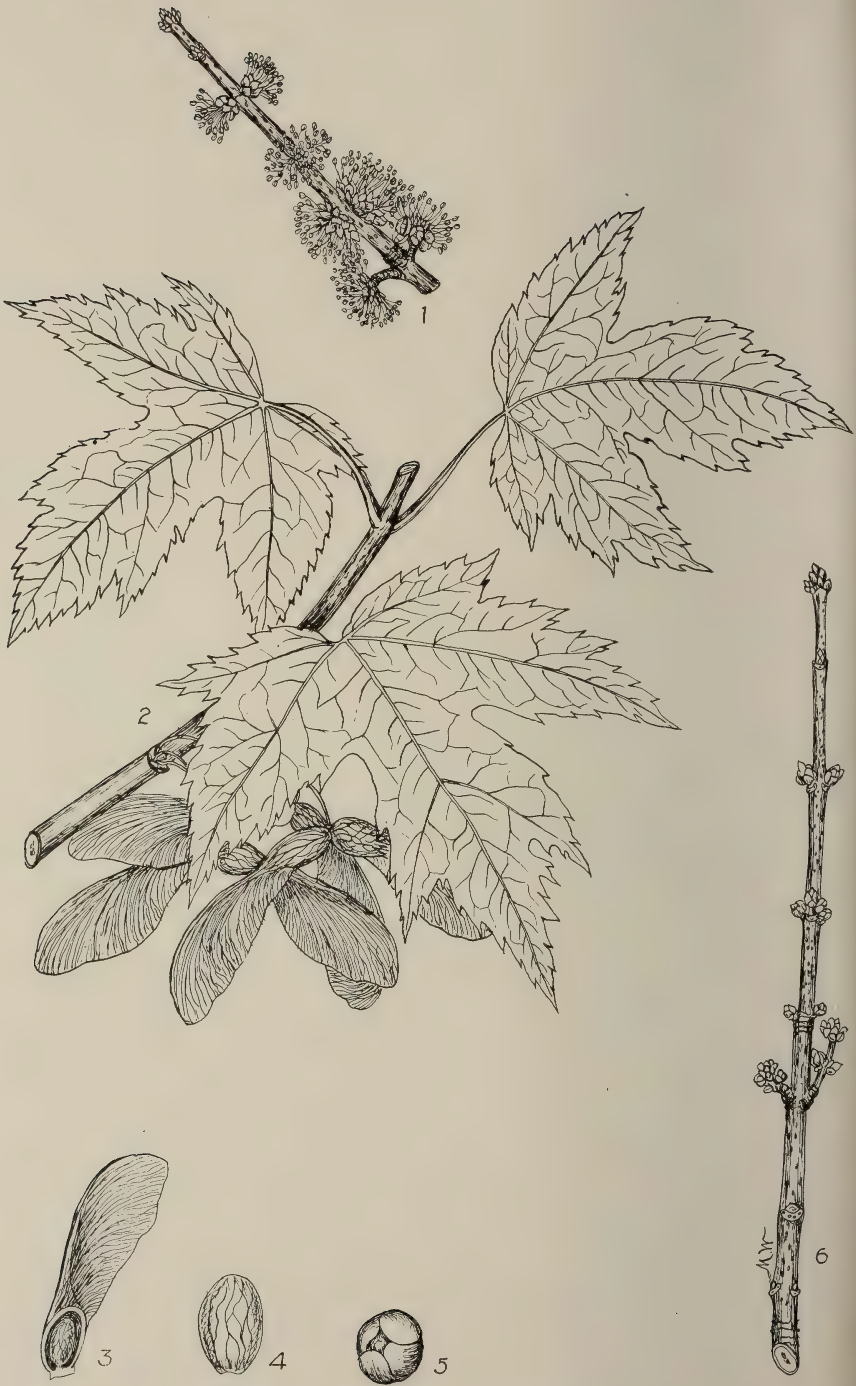

PLATE CVII. SILVER MAPLE.

1. Flowering branch, x ½.
2. Branch with mature leaves and mature fruit, x ½.
3. A wing of a maple key with exposed seed, x ½.
4. A seed, enlarged.
5. End view of a seed, enlarged.
6. A winter twig showing buds, lenticels, leaf-scars, bud-scale scars and bundle-scars, x ½.

SILVER MAPLE.

Acer saccharinum, Linnaeus.

FORM—Usually a tree about 50-60 ft. in height but may attain a maximum height of 120 ft. with a diameter of 4½ feet. Trunk short and divides into lateral branches which again freely subdivide and form a broad head. Lateral branches have pronounced droop, and distinct upward curve at the end.

BARK—On branches and young trunks smooth and gray; on old trunks brown with a somewhat furrowed surface separating into thin flakes which are fastened at the center and loose at both ends.

TWIGS—Somewhat slender, glossy, at first green, later bright chestnut-brown, covered with numerous light lenticels.

BUDS—Opposite, red, obtuse-pointed, sessile or short-stalked; flower buds stout, spherical, accessory, covered with overlapping scales, 6-8 of which may be exposed. Margin of scales ciliated and often light in color.

LEAVES—Opposite, simple, 5-lobed, coarsely toothed; bright green on upper surface and silvery-white on lower; with deep round-based sinuses.

LEAF-SCARS—Opposite, U-shaped to V-shaped, not encircling stem. Bundle-scars 3, in a lunate line.

FLOWERS—Appear in March or April before the leaves are out, in dense, sessile, axillary clusters. Staminate and pistillate occur in separate clusters sometimes on the same, sometimes on different trees. Petals absent.

FRUIT—Matures about May; clustered along branchlets, borne on slender drooping stalks; wings of the keys usually from 1-2 inches long, divergent, sometimes straight, or curved.

WOOD—Diffuse-porous; moderately hard, rather brittle, close-grained, with wide sapwood. Used for flooring, cheap furniture, and paper pulp. Weighs 32.84 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Silver Maple, also known as White Maple, River Maple, and Soft Maple, can be recognized in summer by its leaves with a silvery-white lower surface and deep round-based sinuses. In winter it closely resembles the Red Maple but may be distinguished from it by the pungent odor of the broken twigs and the bright chestnut-brown twigs. The bark of the Silver Maple is somewhat furrowed and separates into thin flakes which are loose at both ends and fastened in the middle. The lateral branches have a pronounced droop and a distinct upward curve at the ends. This may sometimes be a distinctive character. The Red Maple and the Silver Maple are distinguished from all the other Maples of the State by the numerous, round, red, collateral buds.

RANGE—New Brunswick to southern Ontario, south to Florida and Indian Territory.

DISTRIBUTION IN PENNSYLVANIA—Occasional and local throughout the State, especially along larger streams.

HABITAT—It prefers a moist deep soil such as is found along stream banks. It will exist in drier locations but not attain a large size.

IMPORTANCE OF THE SPECIES—The Silver Maple is a very attractive ornamental tree. A few special ornamental varieties have been developed. The wood is brittle and consequently the branches are apt to be broken off during a storm. This defect somewhat checks the planting of this species in exposed places. It is a rapid grower. The wood which it produces is of no special commercial importance and consequently it has little to recommend it for forestry purposes, except that it forms an excellent soil cover in the under-story of the forest.

RED MAPLE.

Acer rubrum, Linnaeus.

FORM—Usually a tree about 50 ft. high, but in a moist habitat sometimes attains a height of over 100 ft. with a diameter of 4 feet. When grown in the open it branches near the ground and forms a deep, broad, dense crown. Upper lateral branches are rather upright while lower ones are horizontal and slightly turned upwards at the end.

BARK—On branches and young trunks smooth and gray; on old trunks dark grayish, thick, shaggy, and roughened by long ridges which peel off in long plates. See Figs. 60 and 61.

TWIGS—Somewhat slender, glossy, at first green, later red, covered with numerous light lenticels.

BUDS—Similar to those of the Silver Maple. See page 195.

LEAVES—Opposite, simple, 3-5-lobed, coarsely-toothed, light green above, pale green to whitish below, with rather shallow sharp-based sinuses.

LEAF-SCARS—Opposite, U-shaped to V-shaped, not encircling stem. Bundle-scars 3, in a lunate line.

FLOWERS—Appear in March or April before the leaves are out, in dense sessile axillary clusters. Staminate and pistillate occur in different clusters, on the same or different trees. Petals present.

FRUIT—Matures in May or June; clustered and borne on drooping stems; wings of the keys usually less than 1 inch long, red to brown in color, at first convergent but later divergent.

WOOD—Diffuse-porous; rather soft, not strong, close-grained, light brown with wide light sapwood. Used for furniture, in turnery, and paper pulp. Weighs 38.5 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Red Maple, also known as Soft Maple, Swamp Maple, and White Maple, can be recognized in summer by its simple, rather small, 3-5-lobed, coarsely-toothed leaves which are rarely silvery-white underneath, and have rather shallow sharp-based sinuses. In winter it closely resembles the Silver Maple, but may be distinguished by its red lustrous twigs and the absence of a pungent odor, from broken twigs. In winter these two closely related species can be distinguished from the Sugar Maple by their numerous, round, red, collateral buds; from the Striped Maple and the Mountain Maple by their larger size and the absence of stalked buds; from the Ash-leaved Maple by the absence of short-stalked downy buds and greenish twig covered with a whitish bloom. The European species, both Norway Maple and Sycamore Maple, have much larger buds and stouter twigs.

RANGE—Nova Scotia to Manitoba, south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common locally throughout the State, especially in regions traversed by streams and in wet habitats.

HABITAT—It prefers wet soil, often found in swamps but also frequents drier hillsides. Commonly found along rivers, creeks, lakes, in swamps, and as an undergrowth in the forest over extensive, and often rather hilly areas.

IMPORTANCE OF THE SPECIES—The Red Maple produces a wood which at present is of little commercial importance. It may in time become more valuable. The despised species of to-day may be the prized species of to-morrow. It is tolerant of shade and its chief future value in forestry may be in furnishing soil protection as a member of the under-story of the forest. It may play the same role in our future forest that Beech is playing to-day in the intensively managed forests of Germany, only that it is of less value for fuel.

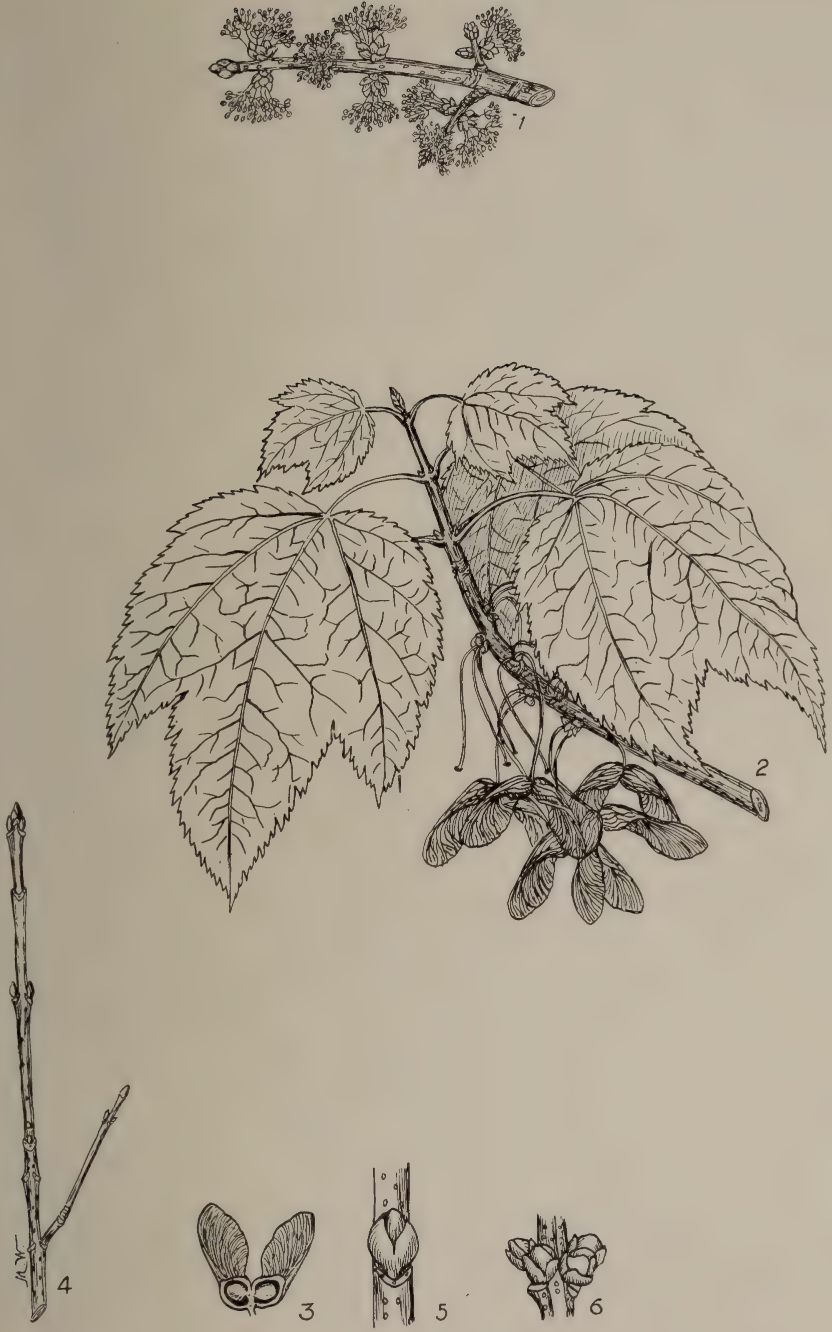

PLATE CVIII. RED MAPLE.

1. Flowering branch, x ½.
2. Branch with mature leaves and mature fruit, x ½.
3. A maple key with exposed seeds, x ½.
4. A winter branch, x ½.
5. Section of winter twig showing lenticels, a leaf-scar and a gaping lateral bud, natural size.
6. Section of twig showing conspicuous lenticels and a cluster of accessory buds, natural size.

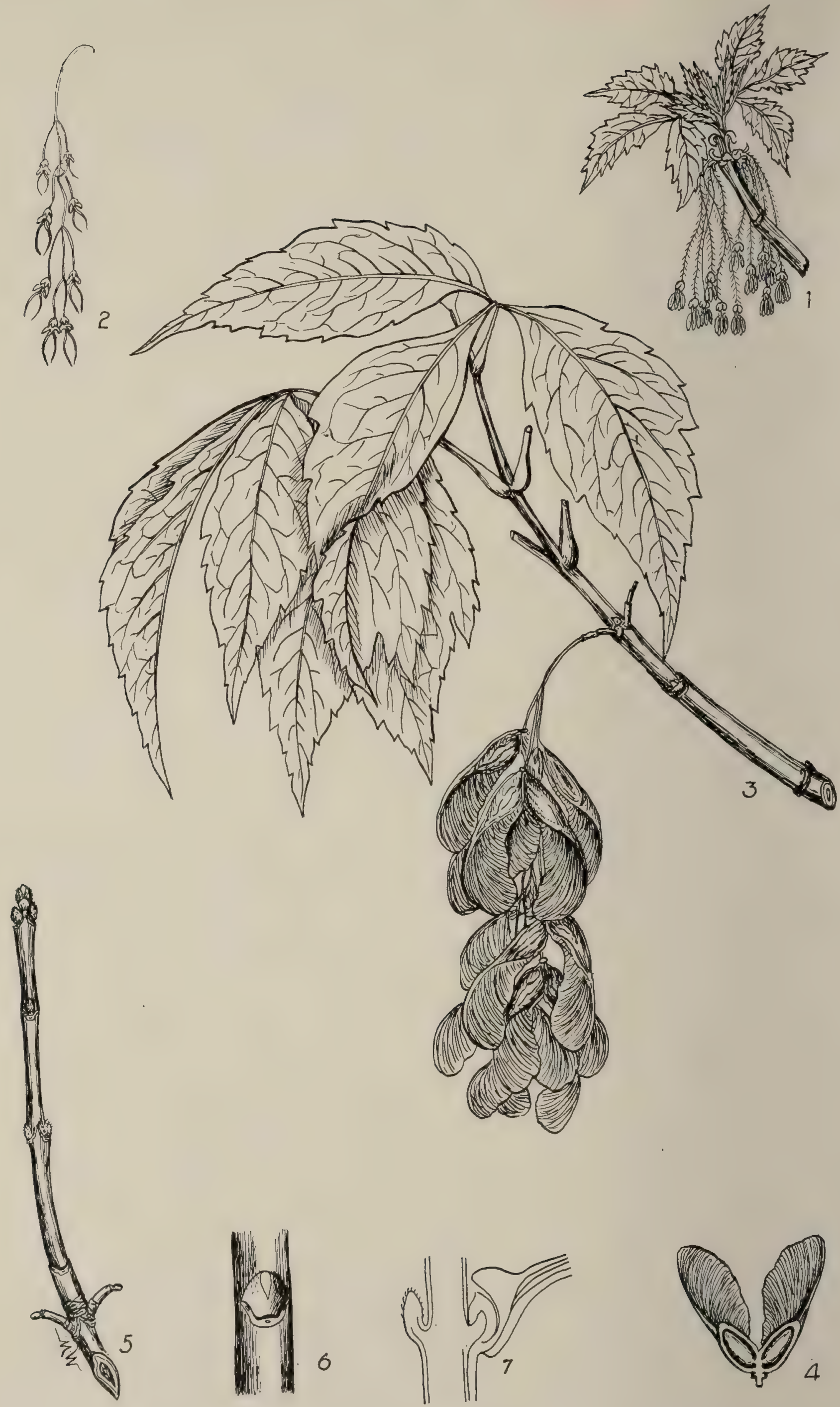

PLATE CIX. ASH-LEAVED MAPLE, or BOX ELDER.

1. Branch with immature leaves and staminate blossoms, x ½.
2. A drooping raceme of pistillate blossoms, x ½.
3. Branch with mature leaves and a raceme of mature fruit, x ½.
4. A key of fruit with exposed seeds, x ½.
5. A winter twig, x ½.
6. Section of a winter twig showing a gaping bud and a leaf-scar with bundle-scars, enlarged.
7. Diagramatic section of a twig with buds and a covering leaf-base, enlarged.

ASH-LEAVED MAPLE, or BOX ELDER.

Acer Negundo, Linnaeus.

FORM—A medium-sized tree occasionally attaining a height of 70 ft. with a diameter of 3 feet. Trunk usually short, dividing into stout, sometimes drooping branches which form a deep broad crown. Occasionally an open grown tree possesses a long clean trunk.

BARK—On branches and young trunks smooth and grayish-brown; that of older ones rather thick, distinctly narrow ridged, and seldom scaly.

TWIGS—Stout, purplish-green or green, sometimes smooth, often covered with a whitish bloom and scattered raised lenticels.

BUDS—Opposite, short-stalked, large, ovoid; the terminal acute and the lateral obtuse; white-woolly, covered by bud-scales, the outer pair usually completely enclosing the inner pair. Collateral buds are common and often distend outer scales.

LEAVES—Opposite, compound, with 3-5 leaflets. Leaflets ovate, coarsely and irregularly serrate, 2-4 inches long and 2-3 inches broad.

LEAF-SCARS—Opposite, V-shaped, bordered by light colored margin, encircling stem so that adjacent edges of opposite scars meet at a very sharp angle. Bundle-scars usually 3, seldom divided, arranged in a lunate line.

FLOWERS—Appear in April before or with the leaves on the past season's growth. Staminate and pistillate occur on different trees, the former on hairy drooping pedicels, the latter in narrow drooping racemes.

FRUIT—Matures about September but is full grown earlier. Wings of the keys about 1½-2 inches long, parallel or incurved, borne in drooping racemes. Fruit-stalks persist far into winter.

WOOD—Diffuse-porous; light, soft, creamy-white, close-grained, not durable. Used in the manufacture of woodenware, cooperage, wood pulp, and sometimes in cheap furniture. Weighs 26.97 lbs. per cubic foot.

DISTINGUISHING CHARACTERISTICS—The Ash-leaved Maple, also known as Box Elder, is readily distinguished in summer by its opposite, compound leaves with 3 to 5 leaflets and its green branchlets covered with a whitish bloom. The maple keys arranged in drooping racemes are also characteristic. In winter the green branchlets are distinctive together with the large, ovoid, often collateral and downy buds. The leaf-scars encircle the stem and their adjacent edges form a very sharp angle.

RANGE—Vermont westward to Ontario, south to Florida, Texas, and Mexico.

DISTRIBUTION IN PENNSYLVANIA—Rare and local. Most abundant in the eastern and southern parts of the State with a few outposts reported in Westmoreland and Allegheny counties.

HABITAT—Thrives best in moist soil, but also tolerant of drier situations. Commonly found along streams, border of lakes or swamps. Often planted for ornamental purposes on dry locations.

IMPORTANCE OF THE SPECIES—It is of little commercial importance as a timber tree. It yields a sap from which some maple sugar is made locally. This tree is very attractive as an ornamental tree and is planted extensively as a shade, lawn, road-side and park tree. It grows rapidly and has an attractive form in winter and a dense green foliage in summer.

SYCAMORE MAPLE.

Acer Pseudo-platanus, Linnaeus.

The Sycamore Maple is a European species. It is native to central Europe where it attains a height of 120 ft. and develops a large spreading head. The trunk is sometimes furrowed and the bark flakes off in thin scales.

This tree is considered the most attractive of the Maples for ornamental planting. It is rather intolerant of soil conditions and consequently not planted so extensively as the Norway Maple.

The Sycamore Maple is readily distinguished by its firm, 3-5-lobed leaves with sharply serrate margins, acute-based sinuses, and pubescent lower leaf-surfaces. In winter the large, obtuse, green buds are characteristic together with the leaf-scars which do not quite encircle the stem. The lenticels are also more numerous and the lateral buds stand out from the twig more than on the Norway Maple. The fruit keys are also smaller and the wings less divergent than those of the Norway Maple.

NORWAY MAPLE.

Acer platanoides, Linnaeus.

The Norway Maple is a European species extending from Norway to Switzerland. It attains a height of 100 ft. and develops a round head. The trunk of the tree is closely fissured but not scaly.

This tree is one of our most attractive ornamental trees and is planted extensively along the streets in cities and in lawns and parks. It is especially adapted for city planting because it is more tolerant of unfavorable city conditions than our native Maples. It is also rather free from the attacks of insects and fungi, and retains the leaves longer in fall than our native species. The wood is of no commercial importance in America, but is used for minor purposes in Europe.

The Norway Maple can readily be distinguished in summer by its large leaves which resemble those of our Sugar Maple, but are deeper in color and firmer in texture. The large-toothed and almost entire-margined leaves are readily recognized from the smaller 3-5-lobed leaves of the Sycamore Maple with sharply serrate leaf-margins. A certain test for identifying the Norway Maple is the presence of milky sap in the leaf-petiole which readily exudes upon twisting. In winter the Norway Maple can be recognized by the large, obtuse, glossy, red buds, which may be more or less olive-green at the base and by the lateral closely appressed buds. The leaf-scars which encircle the stem are also characteristic. The very divergent wings of the large maple keys and the closely fissured, but not scaly bark will also aid in recoging it.

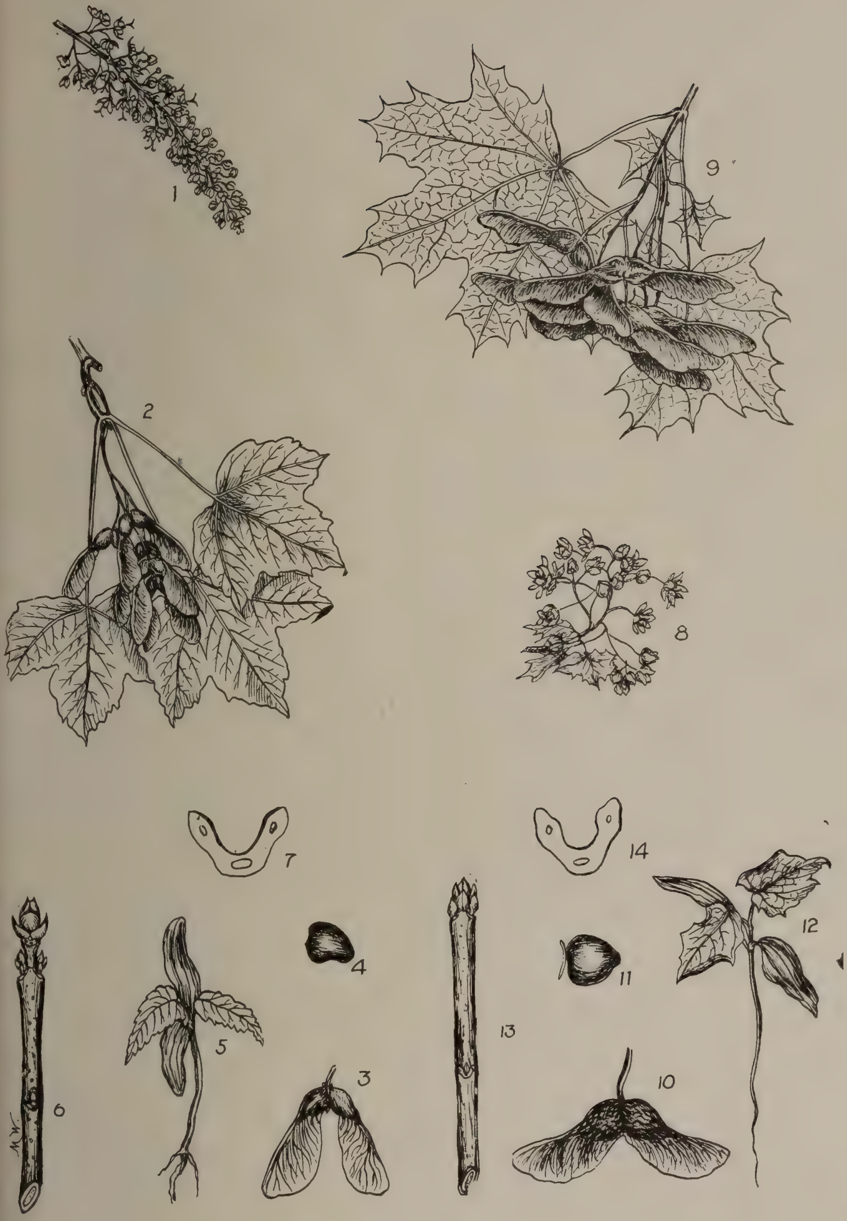

PLATE CX. EUROPEAN MAPLES.

SYCAMORE MAPLE.

1. A spike of flowers, x ⅓.
2. Branch with leaves and fruit, x ¼.
3. A key of fruit, x ⅓.
4. A seed, natural size.
5. A seedling, x ¼.
6. A winter twig, x ½.
7. A leaf-scar, enlarged.

NORWAY MAPLE.

8. A cluster of flowers, x ¼.
9. Branch with leaves and fruit, x ⅓.
10. A key of fruit, x ¼.
11. A seed, natural size.
12. A seedling, x ¼.
13. A winter twig, x ½.
14. A leaf-scar, enlarged.

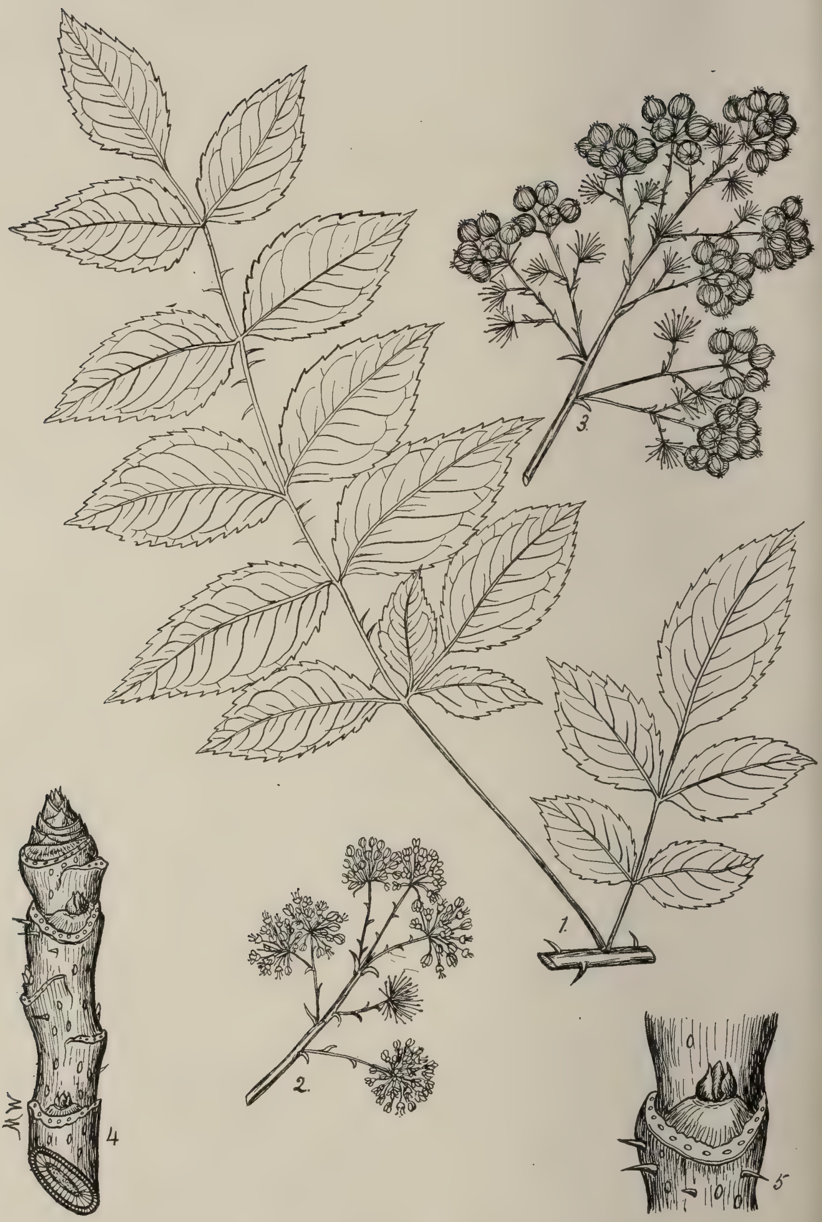

PLATE CXI. HERCULES' CLUB.

1. Section of a branch with compound leaves, x ½.
2. A panicle of flowes, x ½.
3. A panicle of fuit, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, natural size.

HERCULES' CLUB.

Aralia spinosa, Linnaeus.

FAMILY AND GENUS DESCRIPTION—This species belongs to the Ginseng family, Araliaceae, which comprises about 52 genera with 450 species of herbs, vines, shrubs, or trees. The members are widely distributed but commonest in the tropics. The English Ivy (Hedera Helix L.) an evergreen climber is one of its most common representatives. The Common Ginseng (Panax quinquefolium), is a well-known member of this family. The flora of Pennsylvania comprises 2 genera with 6 species. The species described here is the only tree representative in North America. The genus Aralia to which it belongs comprises about 30 species, mostly herbs, native to North America and Asia.

FORM—It may attain a height of 40 ft. with a diameter of 12 inches, but usually 10-20 ft. in height with a diameter of 4-8 inches. Trunk may be branchless or sometimes covered with stout widespreading branches.

BARK—Thin, brown outside, yellow inside, at first smooth, later divided into rounded broken ridges.

TWIGS—Very stout, ½-⅔ of an inch in diameter, armed with stout, scattered prickles, roughened by long narrow leaf-scars which nearly encircle the twig.

BUDS—Alternate; terminal bud present, about ½-¾ of an inch long, chestnut-brown, conical, blunt-pointed. Lateral buds ¼ of an inch long, flattened, often triangular.

LEAVES—Alternate, compound or doubly compound, often 3 ft. long and 2-2½ ft. wide. Leaflets ovate, 2-3 inches long, thick, wedge-shaped or rounded at base, sharp-pointed at apex, serrate on margin, sometimes a little hairy on lower surface. Enlarged bases of the leaf-petioles sheath the twigs.

LEAF-SCARS—Alternate, narrow, long, about half encircle the twig, taper to a point, embrace lateral buds, stand in a horizontal position, i. e. their plane is often at right angles to the main axis of the twig. Each leaf-scar contains about 12 bundle-scars arranged in a curved line.

FLOWERS—Appear from June to August. Each flower is usually perfect and cream white. Many of them are grouped together in panicled-umbels which occur solitary or in groups often 3-4 ft. long.

FRUIT—An ovoid black berry about ¼ of an inch long, 5-angled, and terminated with blackened persistent styles.

WOOD—Soft, brittle, weak, close-grained, brown with yellow streaks; sapwood narrow.

DISTINGUISHING CHARACTERISTICS—The Hercules' Club, also known as Angelica Tree, can be distinguished by its large leaves which may be once, twice, or thrice compound. The leaves are the largest of our native trees. They may be 3-4 ft. long and 2-2½ ft. wide. The petioles have enlarged clasping bases. The terminal buds are conical and ½-¾ of an inch long and the lateral ones are triangular and ¼ of an inch long. The elongated narrow leaf-scars half encircle the twigs. The stout twigs and the petioles are armed. The small white flowers are arranged in panicled-umbels often over 2 ft. long. Its habit of growth is unique in that a number of unbranched but armed stems come up in rather dense clumps.

RANGE—Southern New York to Florida, west to Missouri and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found locally throughout the southern half of the State. Not reported from the northern or northeastern parts. Local outposts of it are reported from the northwestern part.

HABITAT—Prefers rich moist bottomland. Common in moist and fertile woodlands.

IMPORTANCE OF THE SPECIES—This species is of no commercial value. It remains small, produces inferior wood, and is local and limited in its distribution. The tree grows rapidly and is planted rather extensively for ornament.

FETID BUCKEYE.

Aesculus glabra, Willdenow.

FAMILY AND GENUS DESCRIPTION—The Soapberry family, Sapindaceae, comprises about 100 genera with more than 1,000 species. They are widely distributed, but commonest in the tropical regions of the Old World. The flora of North America comprises 6 genera of trees with about 13 species. The genus Aesculus alone has representatives in Pennsylvania. It comprises 14 species, 10 of which are native to America and 2 to Pennsylvania. In addition to the native species, the Horse-chestnut (Aesculus Hippocastanum) is widely introduced in this State.

FORM—Usually a small tree not over 40 ft. in height with a diameter of 12 inches, but may reach a height of 90 ft. with a diameter of 24 inches. Trunk short and slender. Crown broad, deep, round-topped.

BARK—Gray, thick, evidently-furrowed, breaking up into plates.

TWIGS—Stout, at first downy and brown, later smooth, reddish-brown to ashy-gray; ill-smelling if bruised. Pith large, light green, circular in outline.

BUDS—Opposite; terminal buds normally present but occasionally absent; about ⅔ of an inch long, sharp-pointed, resinous, covered by nearly triangular keeled scales. Outer bud-scales reddish-brown, finely hairy on margin, covered with a thin bloom; inner bud-scales yellowish-green, enlarging in spring to 1-2 inches and persisting until leaves are half developed.

LEAVES—Opposite, compound with 5, rarely 7, leaflets. Leaflets ovate to oval, 3-6 inches long, rather long-pointed at apex, narrowed at base, irregularly and finely toothed on margin; when young rather hairy, later smooth, yellowish-green above, paler beneath. Leaf-stalks 4-6 inches long, stout, hairy when young, enlarged at base. Foliage ill-smelling if bruised.

LEAF-SCARS—Opposite, large, heart-shaped to inversely triangular. Bundle-scars large, in more than 3s, usually 3-9, often arranged in 3 groups.

FLOWERS—Appear about April or May after the leaves are developed. Small, yellowish or greenish, with four upright petals; borne in more or less downy terminal panicles about 5-6 inches long and 2-3 inches broad. Pedicels 4-6-flowered. Stamens project beyond yellow corolla.

FRUIT—Matures about October. A thick, round or pear-shaped, prickly capsule about 1 inch in diameter, borne on stout stalks, containing a single large, smooth, lustrous somewhat flattened brown nut. The falling fruit leaves a large scar on the twigs.

WOOD—Diffuse-porous; rays very fine, indistinct; pores very small, invisible to unaided eye, evenly distributed, mostly solitary; wood elements not in tier-like arrangement. Wood is weak, soft, whitish or sometimes pale yellow, lustrous. Weighs 28.31 lbs. per cubic foot. Used for paper-pulp, woodenware, artificial limbs, chip hats.

DISTINGUISHING CHARACTERISTICS—The Fetid Buckeye, also known as Ohio Buckeye, Stinking Buckeye, and American Horse-chestnut, can be distinguished by its leathery, dehiscent fruit containing one to three shining seeds. The fruit of this species is covered with spines while that of the Sweet Buckeye is smooth. The leaves are opposite and digitately compound with usually 5 or occasionally 7 leaflets. The buds are free from a resinous coating; the terminal one is often lacking. The flowers are showy, yellowish or greenish in color and arranged in large panicles borne at the ends of branches. The stamens project beyond the corolla while those of the Sweet Buckeye are just as long or shorter than the corolla. It is native only in the western part of the State.

RANGE—Western Pennsylvania, south to Alabama, west to Illinois, Iowa, and Oklahoma.

DISTRIBUTION IN PENNSYLVANIA—Found only in the extreme western part of the State. Reported from Allegheny, Fayette, Lawrence, Mercer, and Westmoreland counties.

HABITAT—Usually found growing in moist soil. Prefers banks of streams, ravines, or similar situations.

IMPORTANCE OF THE SPECIES—This tree is of no commercial importance in Pennsylvania. It is very limited in its distribution and usually remains small. It is occasionally planted as an ornamental tree, but is less popular than the Horse-chestnut.

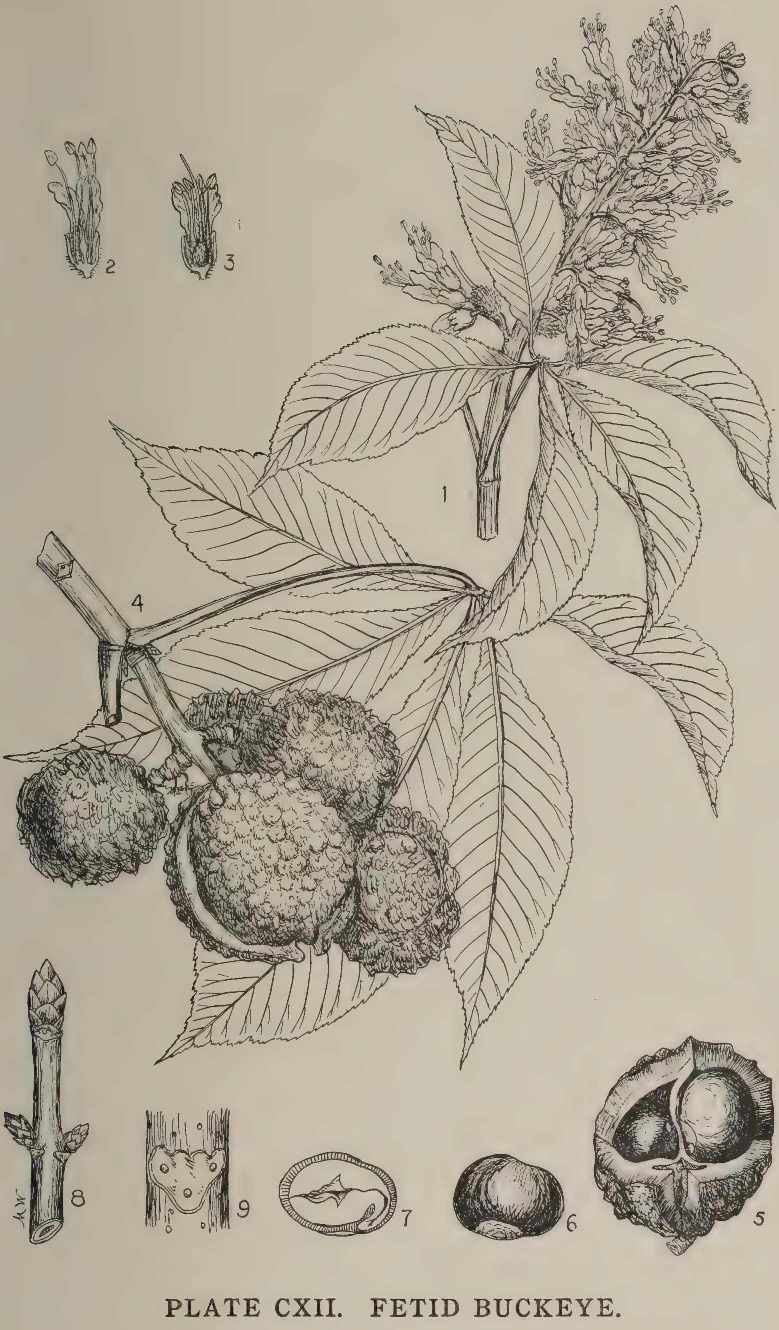

PLATE CXII. FETID BUCKEYE.

1. A flowering branch, x ½.
2. A flower with stigma below anthers, natural size.
3. A flower with stigma above anthers, natural size.
4. A fruiting branch, x ½.
5. A fruit with part of shell removed showing two seeds, x ½
6. A seed, x ½.
7. Longitudinal section of a seed, x ½.
8. A winter twig, x ½.
9. Section of a winter twig showing a leaf-scar with bundle-scars, natural size

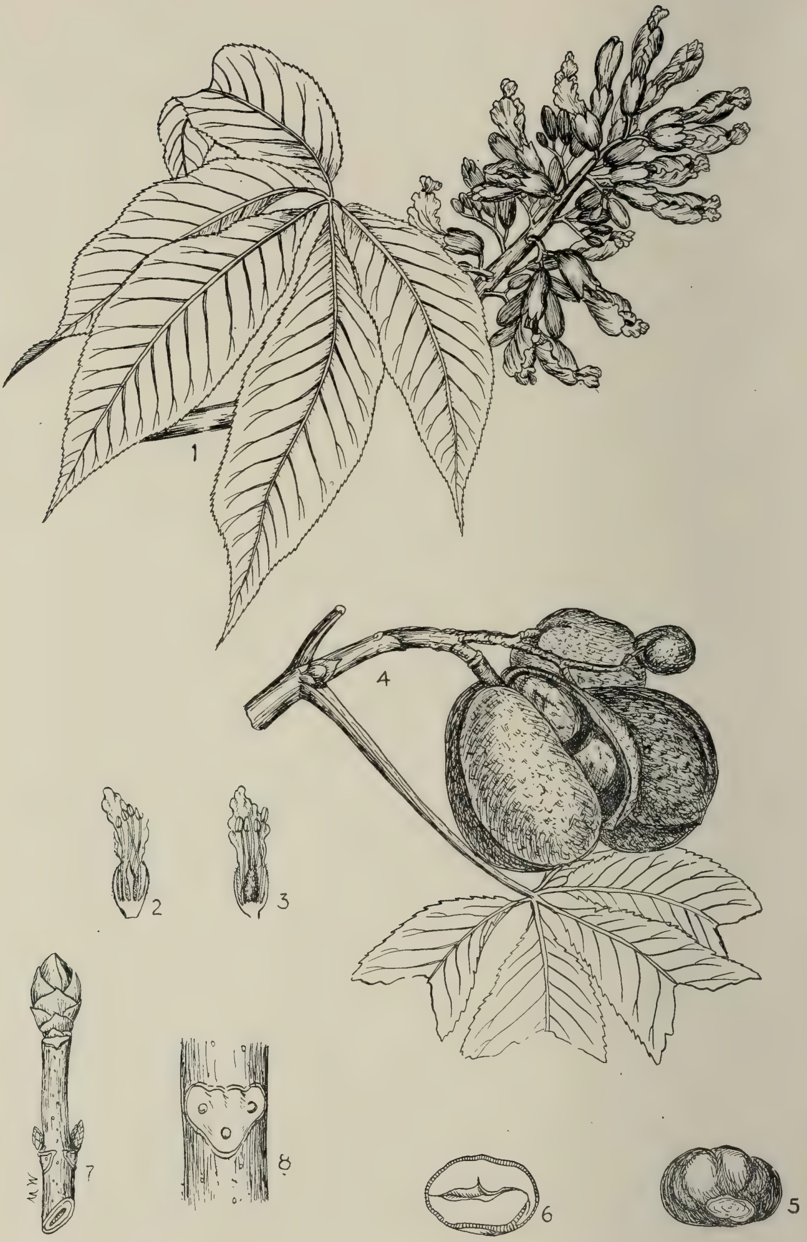

PLATE CXIII. SWEET BUCKEYE.

1. A flowering branch, x ½.
2. A flower with stigma below anthers, natural size.
3. A flower with stigma above anthers, natural size.
4. A fruiting branch, x ½.
5. A seed, x ½.
6. Longitudinal section of a seed, x ½.
7. A winter twig, x ½.
8. Section of a winter twig showing a leaf-scar with bundle-scars, slightly enlarged.

SWEET BUCKEYE.

Aesculus octandra, Marshall.

FORM—The largest American species of the genus. Usually a small tree less than 60 ft. in height with a diameter of 18 inches, but may reach a height of 110 ft. with a diameter of over 3 feet. At its optimum in western North Carolina and eastern Tennessee. Reported a mere shrub in western Texas.

BARK—Light brown to grayish-brown, evidently-fissured, breaking up into many thin irregular scales. See Fig. 58.

TWIGS—Stout, at first finely hairy, becoming smooth, reddish-brown to ashy-gray, slightly ill-smelling when bruised. Pith large, light green, circular in outline.

BUDS—Opposite; terminal bud present and about 4/5-2 inches long; non-resinous, somewhat blunt-pointed, covered by nearly triangular or ovate keeled scales. Outer bud-scales reddish-brown, covered with a thin bluish bloom; inner bud-scales yellowish-green, enlarging in spring to 1-2 inches.

LEAVES—Opposite, compound, with 5, sometimes 7, short-stalked or stalkless leaflets. Leaflets oval to obovate, 4-10 inches long, finely toothed on margin, long-pointed at apex, narrowed at base, dark green and smooth on upper surface when mature, yellowish-green and somewhat hairy on under surface.

LEAF-SCARS—Opposite, large, heart-shaped to inversely-triangular. Bundle-scars large, in more than 3s, usually 3-9, often arranged in 3 groups.

FLOWERS—Appear about April or May when the leaves are developed. Small, yellow or purplish, with 4 conniving petals; borne in finely hairy terminal panicles about 4-12 inches long. Stamens are included in yellow corolla.

FRUIT—Matures about October. A smooth obovoid capsule, about 1-2 inches thick. Seeds several, large, smooth, reddish-brown, lustrous, ¾-1½ inches broad, somewhat flattened. Valves of capsule thin, pale brown, not spiny or warty. The fruit is poisonous to stock, but seldom proves fatal.

WOOD—Similar to that of the Fetid Buckeye, page 200, but it is somewhat lighter in weight and has the wood elements in a tier-like arrangement. Used for lumber, veneer, slack cooperage, paper-pulp, candy boxes, dishes, bowls, and artificial limbs.

DISTINGUISHING CHARACTERISTICS—The Sweet Buckeye, also known as Yellow Buckeye and Big Buckeye, is native only to the extreme western part of the State. The leaves are opposite, digitately compound with usually 5 or sometimes 7 leaflets. The flowers are showy, yellowish in color, and arranged in large panicles borne at the ends of branches. The stamens are usually included in the corolla while those of the Fetid Buckeye project beyond it. The valves of the fruit-capsule are smooth. The twigs are stout, contain a large pith and are roughened by large conspicuous bundle-scars. The buds are large and non-resinous. The twigs when bruised are less ill-smelling than those of the Fetid Buckeye. It is the largest American species of the genus.

RANGE—Western Pennsylvania to Illinois, Iowa, and Oklahoma, south to Georgia and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found only in the extreme western part of the State. Reported from Allegheny county.

HABITAT—Usually grows in mixture with hardwoods in rich soil. Prefers rich bottom-lands and valleys. Common along or near streams.

IMPORTANCE OF THE SPECIES—This tree is of no commercial importance in Pennsylvania. It is very limited in its distribution in the State. The wood which it produces and the small size which it attains in the northern part of its range do not justify its planting for forestry purposes. It is, however, the largest American representative of the genus. It grows rapidly and may be planted for ornamental purposes.

BASSWOOD.

Tilia americana, Linnaeus.

FAMILY AND GENUS DESCRIPTION—The Linden family, Tiliaceae, comprises about 35 genera with probably 375 species found in temperate and tropical regions. The members consist of trees, shrubs, and a few herbs. One genus, Tilia, alone has tree representatives in North America. This genus comprises about 20 species, 8 of which are native to North America and 3 to Pennsylvania. Two species are described here. The third species, known as Michaux's Basswood (Tilia Michauxii Nutt.) is very rare in this State. Its leaves which are densely pubescent and grayish-green beneath and its floral bracts usually rounded at the base are distinctive. The bark of the branches is usually smoother and lighter than that of the 2 other native species.

FORM—A large tree usually attaining a height of 60-70 ft. but may reach a height of 120 ft. with a diameter of 4½ feet. Trunk straight, clean, with little taper. Crown dense, broad, rather deep, ovoid or rounded.

BARK—On old trunks firm but easily cut, thick, longitudinally-furrowed into flat scaly ridges. Ridges often divided by transverse secondary furrows. On young stems dark gray and smooth. See Fig. 79.

TWIGS—Smooth or very finely hairy, shining, bright red; second year olive, olive-red, or covered with a gray skin; usually zigzag, tough, mucilaginous if chewed, covered with scattered, dark, oblong lenticels. In cross-section, characteristic blunt conical masses with intervening lighter colored areas are present.

BUDS—Alternate; terminal bud absent; ovoid, 2-ranked, stout, often somewhat flattened, divergent, usually deep red, occasionally greenish, mucilaginous, smooth or sometimes slightly hairy towards apex. Bud-scales glabrous, thick, rounded at back, usually 3 visible; one large scale makes bud unsymmetrical.

LEAVES—Alternate, simple, ovate to orbicular, 4-7 inches long, firm in texture, long-pointed at apex, deeply toothed on margin with sharp teeth, unequally heart-shaped to truncate at base, dark green and shining on upper surface, green and smooth on lower except for a few rusty hairs. Leaf-stalks slender, ⅓ length of blade. The side of the leaf nearest the branch is the largest.

LEAF-SCARS—Alternate, large, conspicuous, raised, 2-ranked, containing few to many bundle-scars arranged in a ring or a single curved line, or scattered. Stipule-scars distinct, one narrow, the other broad; often show bundle-scars.

FLOWERS—Appear about June. Perfect, regular, sweet, fragrant, yellowish-white, 5-20 in drooping cymose clusters. The long peduncle which bears the flowers is united for about half its length with a conspicuous green bract.

FRUIT—A woody, spherical, nut-like drupe about the size of a pea. Occurs singly or in small clusters with a common stalk attached to a leafy bract and often persisting far into winter.

WOOD—Diffuse-porous; rays distinct, but colorless; light, soft, compact, moderately strong, light brown to nearly white, fine in texture; little difference between spring wood and summer wood. Weighs 28.20 lbs. per cubic foot. Used in the manufacture of paper-pulp, woodenware, cheap furniture, panels for carriages, kegs, pails, barrel headings, berry boxes.

DISTINGUISHING CHARACTERISTICS—The Basswood, also known as Linden, Lime-tree, Whitewood, Beetree, Whistle-wood, and Lynn, may be distinguished by its large, firm unequally based leaves with green and smooth lower surfaces, by its smooth bright red twigs, by its alternate, deep red, unsymmetrical buds with 2-3 visible scales, by its white flowers arranged in drooping clusters attached to a green bract, and by its woody spherical nut-like drupe about the size of a pea attached to winged bracts. The dark funnel-shaped areas in the inner bark alternating with lighter areas as seen in a cross-section of a twig are characteristic. The smooth dark gray bark of younger stems and the thick longitudinally-furrowed bark on older trunks are distinguishing features.

RANGE—New Brunswick to Manitoba, southward to Georgia and eastern Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southeastern parts of the State. Rare in the mountainous parts except in rich valleys. Locally abundant in the western part.

HABITAT—Rarely grows in pure stands, but usually mixed with other hardwoods. Prefers rich soils in bottomlands. It can endure considerable shade. It suffers little from windfall but occasionally from windbreak upon exposed situations.

IMPORTANCE OF THE SPECIES—This tree is one of our important timber trees on account of the valuable wood and the bark which it produces. Seeds or seedlings may be planted. If seedlings are used, they should be planted early in spring before growth starts. The tree sprouts from stump very freely (Fig. 79). It grows rapidly, produces beautiful sweet smelling flowers, and is rarely attacked by fungi. It is one of our most attractive ornamental trees.

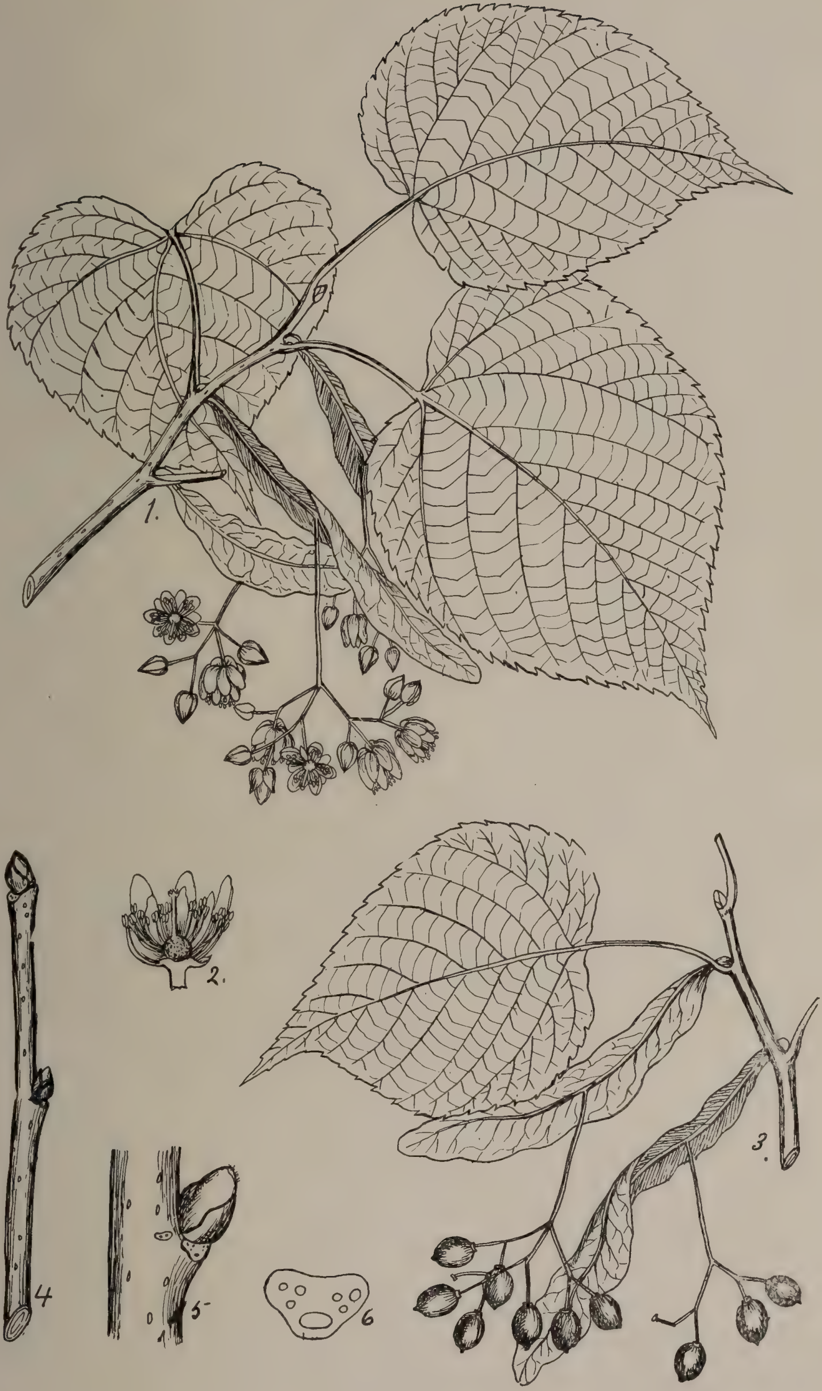

PLATE CXIV. BASSWOOD.

1. A flowering branch with mature leaves, x ½.
2. Longitudinal section of a flower, slightly enlarged.
3. A fruiting branch, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.
6. A leaf-scar with bundle-scars, enlarged.

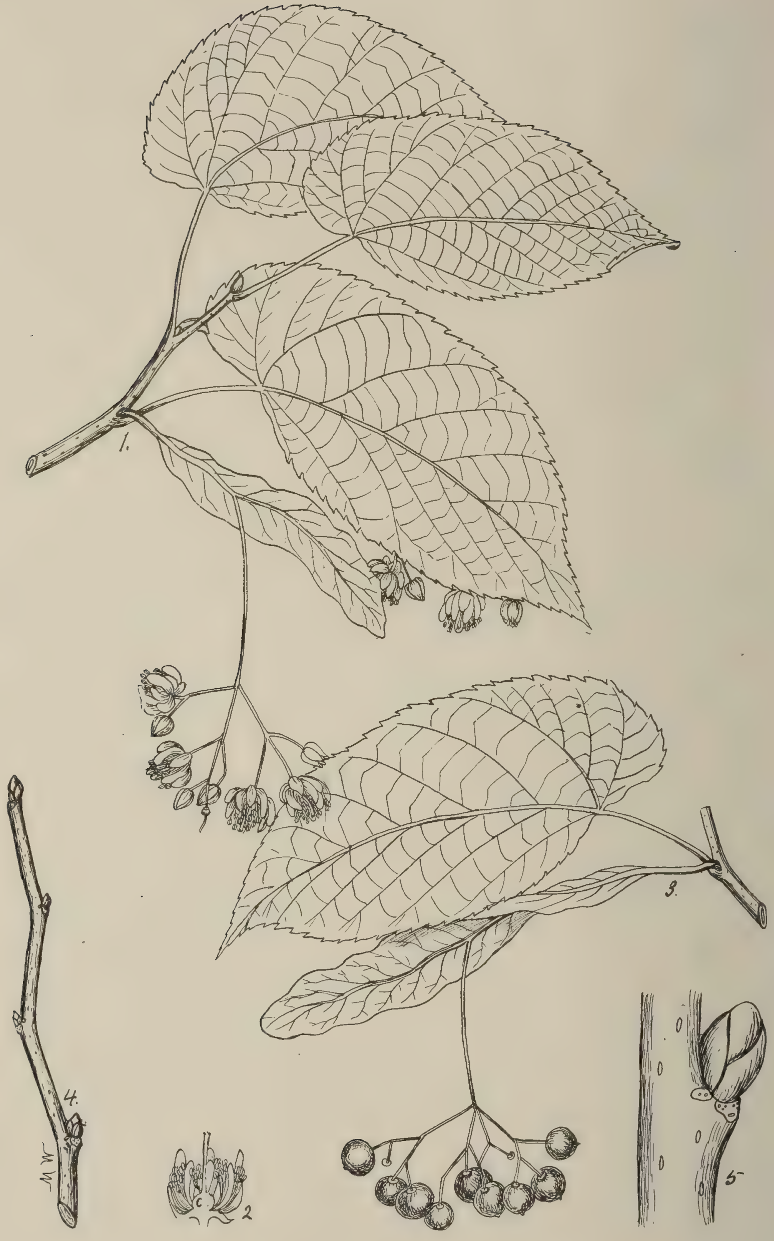

PLATE CXV. WHITE BASSWOOD.

1. A flowering branch with mature leaves, x ½.
2. Longitudinal section of a flower, slightly enlarged.
3. A fruiting branch, x ½.
4. A winter twig, x ½.
5. Section of a winter twig, enlarged.

WHITE BASSWOOD.

Tilia heterophylla, Ventenat.

FORM—Usually 50-60 ft. high but may reach a height of 90 ft. with a diameter of 4½ feet. It becomes as thick but not so high as the Basswood. Trunk straight, clean, slightly tapering. Crown dense, broad, rather rounded.

BARK—Similar to that of the Basswood, page 202.

TWIGS—Similar to those of the Basswood, page 202.

BUDS—Similar to those of the Basswood, page 202.

LEAVES—Alternate, simple, variable in outline, oblong-ovate to orbicular-ovate, 5-8 inches long, firm in texture, short taper-pointed at apex, deeply toothed on margin with sharp teeth, unequally heart-shaped to truncate at base; upper surface dark green and smooth, lower surface silvery-white and finely hairy. Leaf-stalk slender, ¼ length of blade. The side of the leaf nearest the branch is the largest.

LEAF-SCARS—Similar to those of the Basswood, page 202.

FLOWERS—Appear about June or July. Perfect, regular, sweet, fragrant, yellowish-white, 5-15 in drooping cymose clusters. The long peduncle which bears the flowers is united for about half its length with a conspicuous green bract.

FRUIT—A woody, spherical, nut-like drupe about the size of a pea. Occurs singly or in small clusters with a common stalk attached to a leafy bract and often persists far into winter.

WOOD—Similar to that of the Basswood, page 202, only about 2 pounds lighter.

DISTINGUISHING CHARACTERISTICS—The White Basswood, also known as White Linden, has the general characteristics of the Basswood, page 202. It can be distinguished from the latter by its leaves which are slightly larger, silvery-white and finely hairy on the lower surface, while those of the Basswood are green and smooth. The Basswood also reaches a somewhat larger size and has a wider distribution in this State than the White Basswood.

RANGE—New York to Florida, westward to Illinois, Tennessee, and Alabama.

DISTRIBUTION IN PENNSYLVANIA—Locally in the northeastern, eastern, and southern parts. Sparse in the mountainous parts. Not known to occur in the western part.

HABITAT—Usually found in rich woods in mountainous regions. Tolerates dense shade, but thrives in full light. Occurs in mixture with other hardwoods. Common on limestone soil.

IMPORTANCE OF THE SPECIES—This tree is of little commercial importance in this State on account of its limited distribution. Farther south it is more abundant, being the prevailing Basswood of West Virginia. It is one of our most attractive ornamental trees.

FLOWERING DOGWOOD.

Cornus florida, Linnaeus.

FAMILY AND GENUS DESCRIPTION—The Dogwood family, Cornaceae, comprises about 15 genera found mostly in temperate regions. Only 2 genera are native to North America, both of which have representatives in this State. They are the Dogwoods, Cornus, and the Gums, Nyssa. The genus Cornus is widely distributed in temperate regions and comprises about 40 species of which number 15 are native to North America and 8 to Pennsylvania. A few species reach tree-size and yield a very hard and valuable wood.

FORM—A small tree usually from 15-25 ft. high but may reach a height of 40 feet with a diameter of 18 inches. Trunk with little taper up to the first branches and then practically disappears entirely in the branches. Crown low, broad, high, and rather dense.

BARK—On younger stems and branches light brown to reddish-gray and rather smooth. On older stems reddish-brown to black, broken up into quadrangular scaly blocks. Bark rather bitter and ill-smelling. See Fig. 103.

TWIGS—Usually red, sometimes tinged with green, smooth, glossy, often covered with a glaucous bloom; lenticels few and small; pith white and gritty.

BUDS—Opposite; terminal bud present. Flower-buds terminal, spherical, 1/5-2/5 of an inch broad, covered by two opposite pairs of bud-scales. Lateral buds small often covered by persistent bases of leaf-stalks. Terminal leaf-buds reddish, slightly downy, covered by 2 gaping bud-scales.

LEAVES—Opposite, simple, clustered towards end of branches, ovate, 3-5 inches long, 2-3 inches wide, acute at apex, wedge-shaped at base, entire to wavy on margin, bright dark green above, pale below. Midrib and primary veins prominent.

LEAF-SCARS—Opposite, may or may not encircle stem; bundle-scars 3 and occasionally more. Evidently-raised on the base of leaf-stalks on season's growth, and forming a deep V-shaped notch between them.

FLOWERS—Appear about April. Perfect, greenish, arranged in dense heads, and surrounded by a large white involucre which is often mistaken for the corolla.

FRUIT—Ripens about October. A scarlet ovoid drupe about 3/5 of an inch long, containing a grooved stone, borne solitary or in clusters of 2-5 on a stalk. Undeveloped pistillate flowers often persist about base of fruit.

WOOD—Diffuse-porous; medullary rays distinct; light red or pink in color. Wood very heavy, hard, strong, tough, pale reddish-brown to pinkish, with lighter colored sapwood. Weighs 50.81 lbs. per cubic foot. Used for shuttles, golf stick heads, brush blocks, wedges, engraver's blocks, tool handles, and many kinds of turnery.

DISTINGUISHING CHARACTERISTICS—The Flowering Dogwood, also known as Boxwood, Dogwood and Flowering Cornel, can be distinguished by its opposite branching, bright red or occasionally greenish twigs, small lateral buds covered by the persistent bases of the leaf-stalks, large spherical flower-buds, terminal leaf-buds with a single pair of bud-scales, and by its alligator bark. In autumn the fruit, and in spring the flowers, also aid in distinguishing it.

RANGE—Massachusetts west through Ontario to Michigan and Missouri and south to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Locally throughout the State; most common in the eastern and southern parts.

HABITAT—Prefers well drained soil but will grow on most of our soils. Generally prevalent but most common and thrives best in low, moist, and rather fertile situations. Usually found in the understory of the forest.

IMPORTANCE OF THE SPECIES—The Flowering Dogwood is valuable for ornamental purposes and for its wood. Few trees surpass it in beauty when in bloom and when fruiting. In this State it does not reach a sufficient size to be of commercial importance. It should be maintained in our forest on account of its beauty and its value as a soil improver, since it is very tolerant and will grow readily in the understory of the forest.

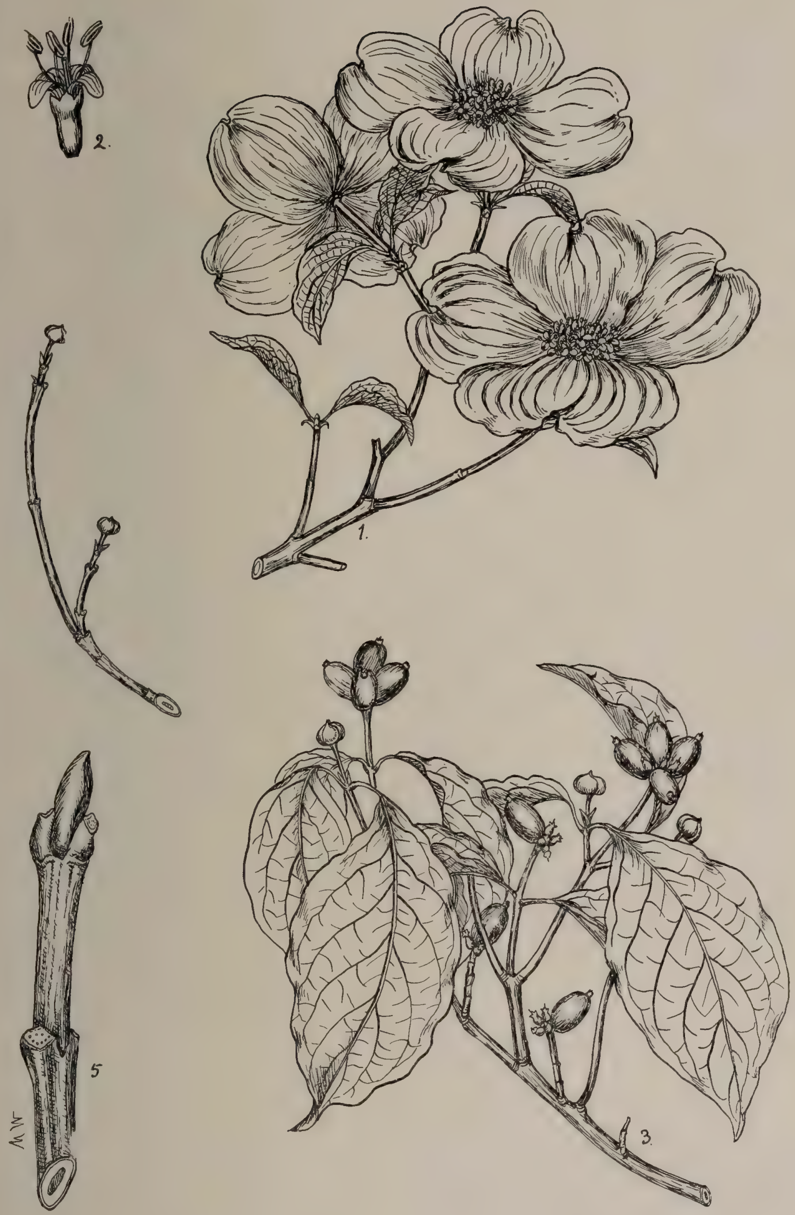

PLATE CXVI. FLOWERING DOGWOOD.

1. A flowering branch, with three clusters of flowers, each surrounded by a showy 4-bracted white involucre, x ½.
2. A single flower, enlarged.
3. A fruiting branch with mature leaves, x ½.
4. A winter twig with two terminal spherical flower buds, x ½.
5. Terminal section of a winter twig showing leaf-scars and leaf-buds, enlarged.

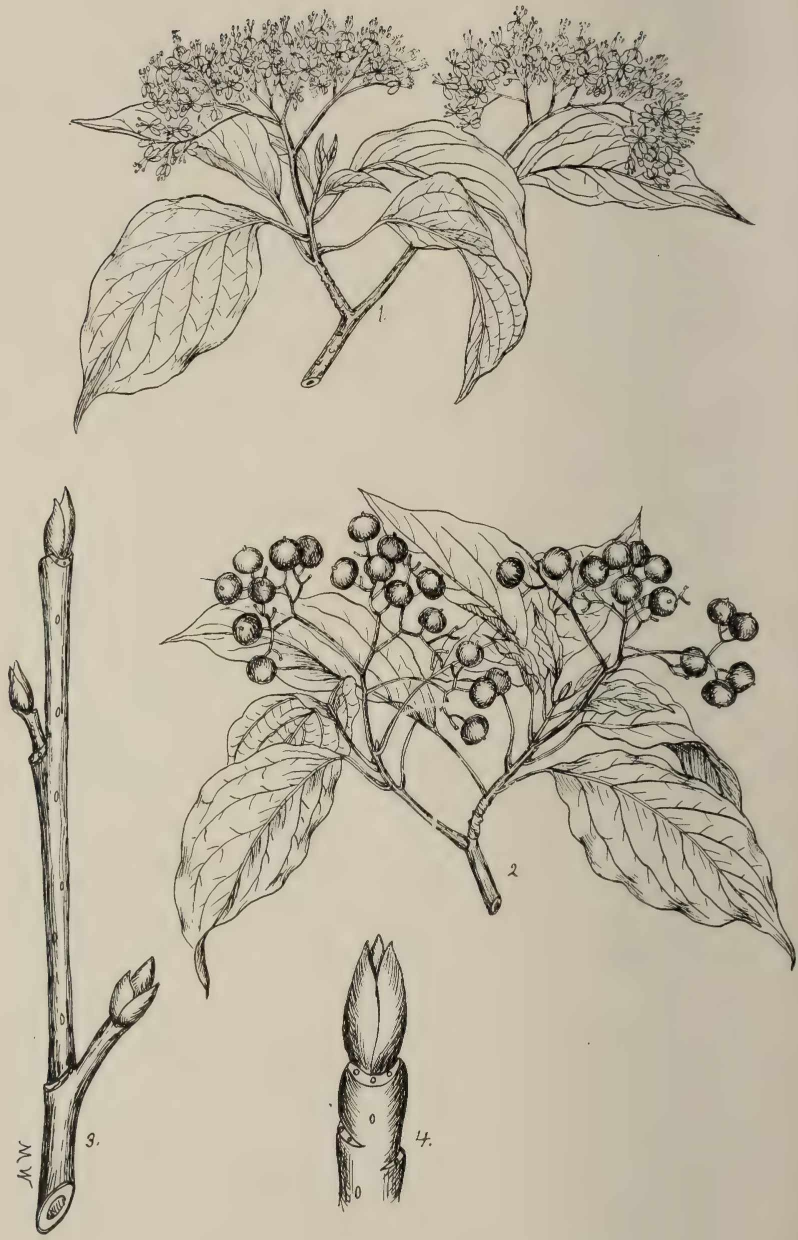

PLATE CXVII. ALTERNATE-LEAVED DOGWOOD.

1. A flowering branch, x ½.
2. A fruiting branch, x ½.
3. A winter twig, natural size.
4. Terminal section of a winter twig, enlarged.

ALTERNATE-LEAVED DOGWOOD.

Cornus alternifolia, Linnaeus.

FORM—A small tree usually about 10-20 ft. high but may reach a height of 30 ft. with a diameter of 8 inches. Trunk is short. Crown broad, deep, flat-topped, and dense.

BARK—Rather thin; on younger stems greenish streaked with white, and smooth; on older stems reddish-brown and roughened by shallow longitudinal fissures which are sometimes joined transversely.

TWIGS—Alternate, rather slender and flexible, smooth, often glossy, at first reddish-green, later dark green and often striped with white; bitter to the taste and emitting an offensive smell if punctured; marked with lunate leaf-scars and scattered lenticels.

BUDS—Alternate, rarely opposite, oval, sharp-pointed, covered with a few, usually 2-3, chestnut-brown scales. Outer scales are often separated towards apex.

LEAVES—Alternate, sometimes opposite, simple, frequently clustered at end of branches, 3-5 inches long, 2-3 inches wide, ovate, acuminate at apex, wedge-shaped at base, entire or wavy on margin, bright green above, usually almost white downy below.

LEAF-SCARS—Alternate, sometimes opposite, situate on extensions of the twigs, with their surfaces often at right angles to twigs; in outline resemble the moon in first quarter and containing 3 bundle-scars.

FLOWERS—Appear about April. Cream-colored, perfect, borne in many-flowered terminal cymes.

FRUIT—A dark blue spherical drupe, ⅓ of an inch in diameter, tipped with remnants of the style, borne in cymes. Ripens in October.

WOOD—About the same as the flowering dogwood, but no uses of it are reported.

DISTINGUISHING CHARACTERISTICS—The Alternate-leaved Dogwood, also known as Blue Dogwood, Purple Dogwood, Green Osier, and Pigeon-berry, may be distinguished by its alternate branching, reddish-green to dark green twigs, cream-colored flowers and dark blue fruit arranged in cymes. It does not have the alligator bark of the Flowering Dogwood and usually frequents moister habitats.

RANGE—Nova Scotia to Alabama, and westward to Minnesota.

DISTRIBUTION IN PENNSYLVANIA—Throughout the State. Common in the portions which are well watered.

HABITAT—Prefers moist well drained soil. Most common along streams and other bodies of water and border of woodlands. Very tolerant of shade.

IMPORTANCE OF THE SPECIES—The Alternate-leaved Dogwood is of little commercial importance. It is very pretty and may be of value as a soil-conserver and improver.

BLACK GUM.

Nyssa sylvatica, Marshall.

GENUS DESCRIPTION—The genus Nyssa is rather limited in its distribution being confined to the eastern United States and southern Asia. It comprises 7 species in the world 5 of which are native to North America and 1 to Pennsylvania. All the representatives produce wood which is very tough on account of its twisted and contorted grain.

FORM—Usually a medium-sized tree with a height of 15-40 ft., but may reach a height of 100 ft. with a diameter of 5 feet. Trunk straight and rather continuous. Many lateral branches are horizontal; some of the lower are drooping and the upper ascending. Old trees often have a low flat crown but have their middle and lower trunk covered with small horizontal branches.

BARK—Grayish, smooth to scaly on young trunks; reddish-brown to grayish-black, very rough and scaly on older trunks. Forms what is known as alligator bark on very old trunks characterized by quadrangular and hexagonal blocks. See Fig. 100.

TWIGS—Smooth, with few lenticels, grayish to reddish-brown; pith rather large, white, separated by layers of stone cells which may be seen with magnifying glass.

BUDS—Alternate, ovate, reddish-brown, ¼ of an inch long, usually smooth, covered by 3-5 visible, ovate, closely overlapping scales. Lateral buds sometimes superposed, smaller than terminal one. Buds originate close to leaf-scar and occasionally protrude into it.

LEAVES—Alternate, simple, oval, 2-5 inches long, acute at apex, wedge-shaped at base, entire and slightly thickened on margin, dark green and shiny above, often hairy below, turning to a gorgeous red in fall.

LEAF-SCARS—Alternate, conspicuous, rather large, broadly crescent-shaped, with three single or 3 groups of bundle-scars, which are conspicuous on account of size; brownish in color, contrasting with lighter surface of the leaf-scar.

FLOWERS—Appear in May or June. Borne on long slender somewhat downy stalks. Staminate and pistillate flowers separate. Staminate occur in dense many-flowered heads; pistillate in open few-flowered clusters.

FRUIT—A small, dark blue, fleshy berry or drupe, ovoid, ⅔ of an inch long, 1-3 in a cluster, often with a few remnants of undeveloped pistillate flowers at base. Borne on long stalks. Ripens in October.

WOOD—Diffuse-porous; rays indistinct; growth-rings usually indistinct; pores numerous, small, uniform in size and distribution; wood cross-grained, tough to split, difficult to work, not hard, moderately strong and stiff, not durable, light yellow. Weighs 36.91 lbs. per cubic foot. Used for hubs of wheels, boxes, ironing boards, rolling pins, chopping bowls, excelsior, broom handles, baskets, and berry crates.

DISTINGUISHING CHARACTERISTICS—The Black Gum, also known as Sour Gum, Tupelo, and Pepperidge, can be distinguished by its alligator bark when old, grayish to reddish-brown smooth clear twigs when young which are marked with conspicuous leaf-scars with three bundle-scars. The buds diverge very much from the twigs and may be superposed. Lateral branches on young trees often take a horizontal position. The separation of the pith by stone cells, the gorgeous red color of the autumnal foliage, and the bluish berries also aid in recognizing it.

RANGE—Maine to Tampa Bay, Florida; west to southern Ontario and Michigan, southward to Texas.

DISTRIBUTION IN PENNSYLVANIA—Very common in the eastern, central, and southern parts, local in western part, rarer in northern part. Reaches large size in swamps of Adams and Franklin counties.

HABITAT—Found in variable habitats. Very common on burnt-over areas, on dry mountain slopes, abandoned fields, abandoned charcoal hearths; but reaches its best development along streams and in low wet situations. While it has preferences it is not a chooser of habitats.

IMPORTANCE OF THE SPECIES—The Black Gum has been despised since the early farmers tried to split it for fence rails. It is slowly gaining favor, but is not of sufficient importance to be recommended for forest planting. Its autumnal foliage is beautiful and in winter the form of young trees is very attractive.

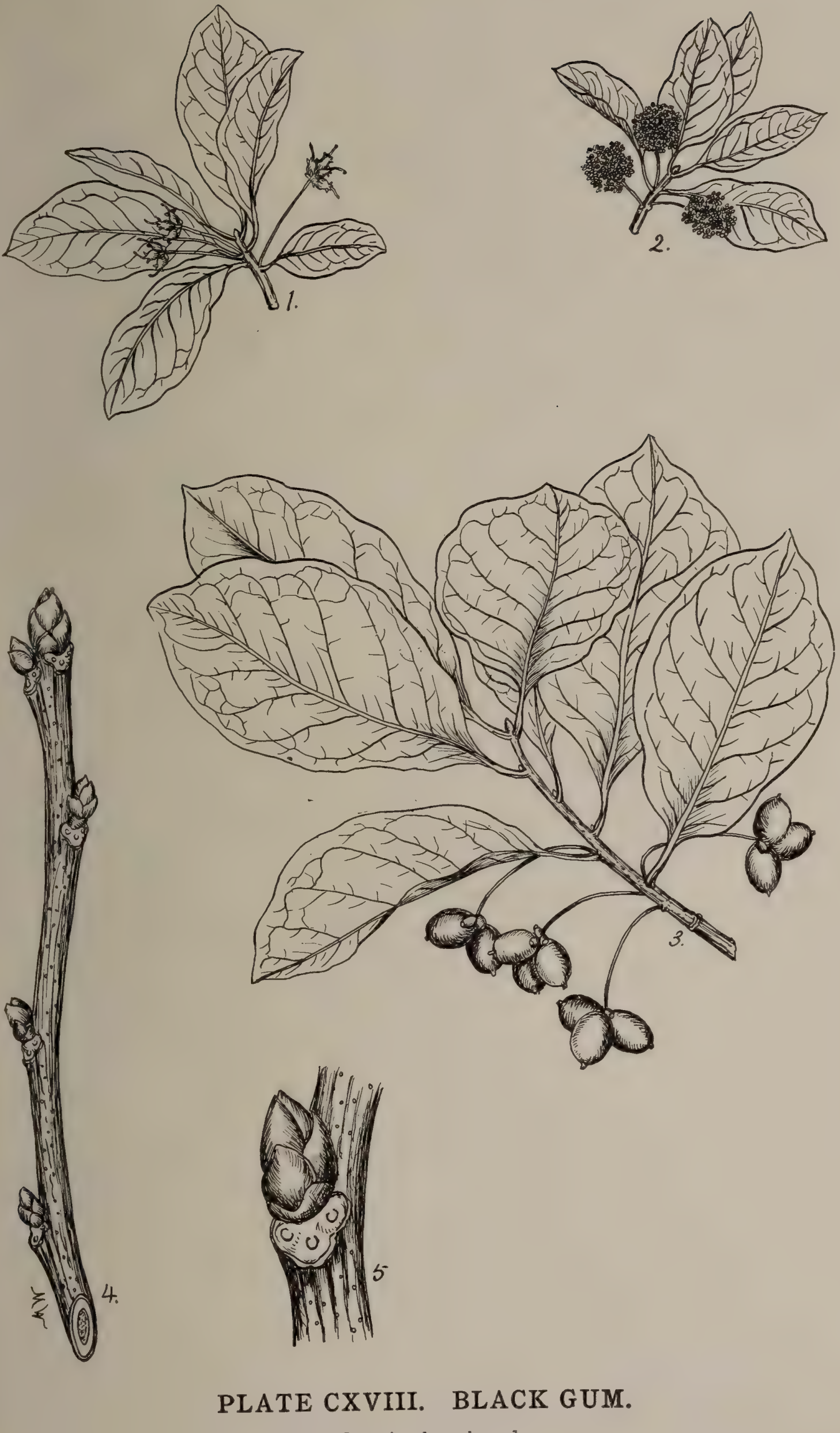

PLATE CXVIII. BLACK GUM.

1. A pistillate flowering branch, x ½.
2. A staminate flowering branch, x ½.
3. A fruiting branch with mature leaves, x ½.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

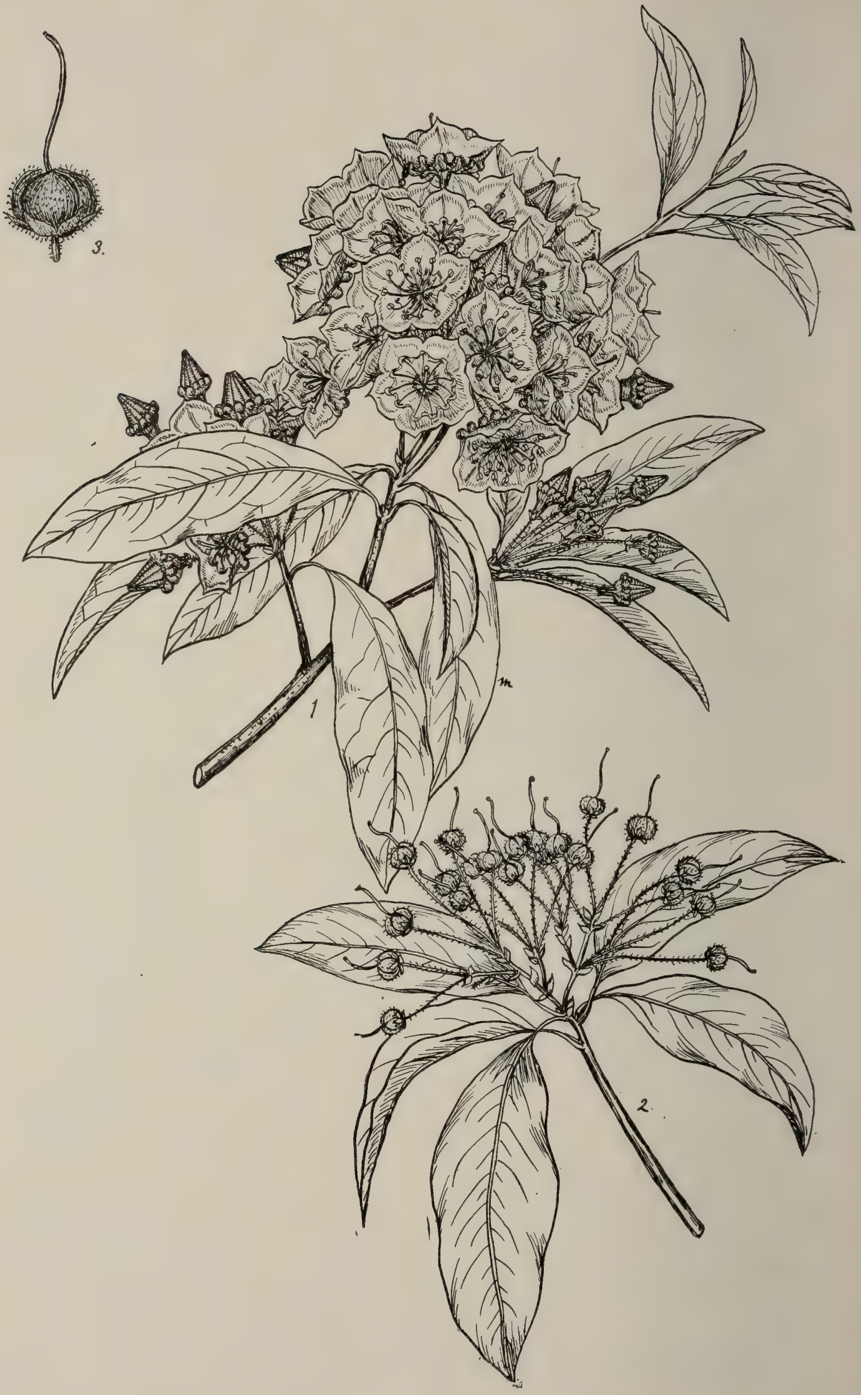

PLATE CXIX. MOUNTAIN LAUREL.

1. Flowering branch with (i) immature leaves, (m) mature leaves, and with open and closed blossoms, x ½.
2. Branch with mature leaves and mature fruit, x ½.
3. A fruit, enlarged.

MOUNTAIN LAUREL.

Kalmia latifolia, Linnaeus.

FAMILY AND GENUS DESCRIPTION—The Heath family, Ericaceae, embraces species which are amongst our best known and most popular shrubs. The Huckle-berries, Blueberries, Cranberries, Azaleas, Kalmias, and Rhododendrons are some of the commonest representatives. Very few representatives are of any special economic value on account of the wood which they produce. Some are important on account of their aesthetic value, while others yield valuable food or are used in medicine. This family comprises about 90 genera with more than 1,400 species, of which number about 40 genera are found in the United States, 7 of which have tree representatives. The flora of Pennsylvania comprises 27 genera with about 45 species. Since most of them are shrubs only 3 species representing 3 genera are described here. The genera here described are Kalmia, Rhododendron, and Oxydendrum.

The genus Kalmia comprises 5 or 6 species in North America and Cuba. The species described on this page is the only one which reaches tree-size. Two other shrub species, Sheep Laurel (Kalmia angustifolia L.) and Swamp Laurel (Kalmia polifolia Wang.), are also native to this State. The genus is named after Peter Kalm, a Swedish naturalist, who traveled in North America during the middle of the 18th century.

FORM—In Pennsylvania usually a shrub 5-10 ft. in height with a stout stem which is usually forked, often inclined and bearing divergent branches which form a round compact head. In the South it reaches a height of 30-40 ft. with a diameter of 20 inches.

BARK—Very thin, reddish-brown, furrowed, peels off into long, narrow, thin scales exposing cinnamon-red inner bark.

TWIGS—At first reddish-green covered with viscid hairs, later becoming decidedly green, and finally brown. Rather smooth except where roughened by leaf-scars and bud-scale scars.

BUDS—Alternate, ovate, sharp-pointed, greenish in color. Leaf-buds are formed early and appear below the clustered flower-buds. Flower-buds are covered by numerous, downy and overlapping green scales which are coated with glandular hairs and enlarge with the developing shoot in spring.

LEAVES—Alternate, sometimes paired, simple, oblong, wedge-shaped at base, entire-margined, acute at apex sometimes tipped with bristle point, 3-4 inches long, about ½ of an inch wide. Mature leaves are thick, leathery, dark green, glossy above, yellowish-green below, and persist for two seasons.

LEAF-SCARS—Large, imbedded in twig, with a cluster of bundle-scars.

FLOWERS—Emerge from flower buds which begin to expand in early spring and open about May or June. Flowers are borne on red or green scurfy stalks and arranged in dense many-flowered corymbs which have a diameter of about 4 inches. Calyx is divided into five parts. Corolla is white to rose-colored and viscid pubescent.

FRUIT—Matures about September. It is a many-seeded woody capsule, roundish in outline but slightly five-lobed and covered with viscid hairs. Both style and calyx persist. Each capsule produces many seeds.

WOOD—Diffuse-porous; heavy, hard, strong, rather brittle. Heartwood reddish-brown, sapwood lighter colored. Weighs 44.62 lbs. per cubic foot. Where it grows to a fair size it is an excellent wood for fuel. It is also used in manufacture of tool handles, penholders, bucket handles, turnery, and tobacco pipes. About 85,000 lbs. of this wood are produced annually in North Carolina for pipes.

DISTINGUISHING CHARACTERISTICS—The Mountain Laurel, also known as Kalmia and Calico-Bush, is one of our few broad-leaved species whose leaves persist over winter. It can be distinguished from all other species native to this State by its thick leathery leaves which are 3-4 inches long, persistent, decidedly glossy on upper surface and yellowish-green on lower surface. The Great Laurel or Rhododendron is also evergreen but its leaves and buds are much larger than those of the Mountain Laurel. The leaves of the Mountain Laurel are shorter, narrower, and sharper-pointed than those of the Rhododendron.

RANGE—New Brunswick south generally along the mountains to Florida, west to Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Throughout the State. Most common in the mountainous parts, where it often forms almost impenetrable thickets.

HABITAT—Common along margins of swamps and as an understory in deciduous forests. Also found on hillsides and hilltops. Very common on rocky and round hilltops.

IMPORTANCE OF THE SPECIES—The Mountain Laurel remains too small in this State to be of commercial importance on account of the wood which it produces. Next to Rhododendron, it is the most attractive native shrub found in our flora. It is a favorite with lovers of the woods who admire not only its blossoms, but also its leaves and its habit of growth.

GREAT LAUREL.

Rhododendron maximum, Linnaeus.

GENUS DESCRIPTION—The name Rhododendron is of Greek origin and means Rose tree. It comprises about 100 species of shrubs and a few small trees in the northern hemisphere. About 10 species are native to North America and 1 to Pennsylvania.

FORM—A shrub or small bushy tree. In this State usually a shrub from 5-12 ft. in height, but in the mountains of the South it may reach a height of 35 feet. Stems often twisted, bearing contorted branches which form an irregular round head.

BARK—Thin, reddish-brown, at first close, later peeling off into thin scales.

TWIGS—At first green and coated with rusty pubescence but become smooth during first winter, and gradually turn to bright red-brown.

BUDS—Alternate; leaf-buds and flower-buds distinct. Leaf-buds usually axillary sometimes terminal, dark green, cone-shaped, form in midsummer. Flower-buds usually terminal, cone-shape, 1-1½ inches long, covered by numerous, overlapping, green bracts.

LEAVES—Alternate, simple, persistent, clustered at apex of branches, ovate to oblong, acute at apex, rounded to wedge-shaped at base, entire on margin, 4-11 inches long, 1½-2½ inches wide, thick, leathery, smooth and dark green on upper surface, whitish on lower surface.

LEAF-SCARS—Alternate, slightly raised, conspicuous, rounded at base, slightly depressed at top, with several bundle-scars arranged in a U-shaped line.

FLOWERS—Appear about June after the new leaves are fully developed, are arranged in umbel-like clusters about 4-5 inches in diameter and borne on glandular pedicels. Individual flowers are perfect, pale rose to white in color; upper petals marked by yellowish-green dots.

FRUIT—A dark reddish-brown capsule about ½ of an inch long, which persists until the following season. Capsules split open lengthwise liberating oblong flattened seeds. Surrounded at the base by persistent calyx and terminated by persistent linear style.

WOOD—Diffuse-porous; hard, strong, brittle, light brown with lighter sapwood. Weighs 39.28 lbs. per cubic foot. Of little commercial use but occasionally manufactured into tool handles and engraving blocks. Excellent for fuel where it reaches a fair size.

DISTINGUISHING CHARACTERISTICS—The Great Laurel, also known as Rhododendron and Rose Bay, can be distinguished from all other species of trees native to Pennsylvania by its large, persistent, leathery, simple leaves which are clustered towards the end of the branches and alternate in their arrangement. Its shrubby form and its preference for moist habitats also aid in distinguishing it. The conical flower-buds, which are usually terminal and often over an inch long, are also characteristic. The twigs are evidently marked by the bud-scale scars.

RANGE—Nova Scotia and Lake Erie on the north, south along the mountains to northern Georgia.

DISTRIBUTION IN PENNSYLVANIA—Found throughout the State. Rare in the southeastern part. Abundant throughout the mountainous parts.

HABITAT—In the North frequents a cold swampy situation. In the South it ascends the mountains to 3,000 feet but remains along the banks of streams. Tolerates most soils except limestone.

IMPORTANCE OF THE SPECIES—The Rhododendron does not reach a large enough size in Pennsylvania to produce wood of commercial importance. In the South it often becomes a tree. It is the most attractive shrub in our flora, and will thrive in a variety of situations but prefers moist locations and flees from soils which contain lime.

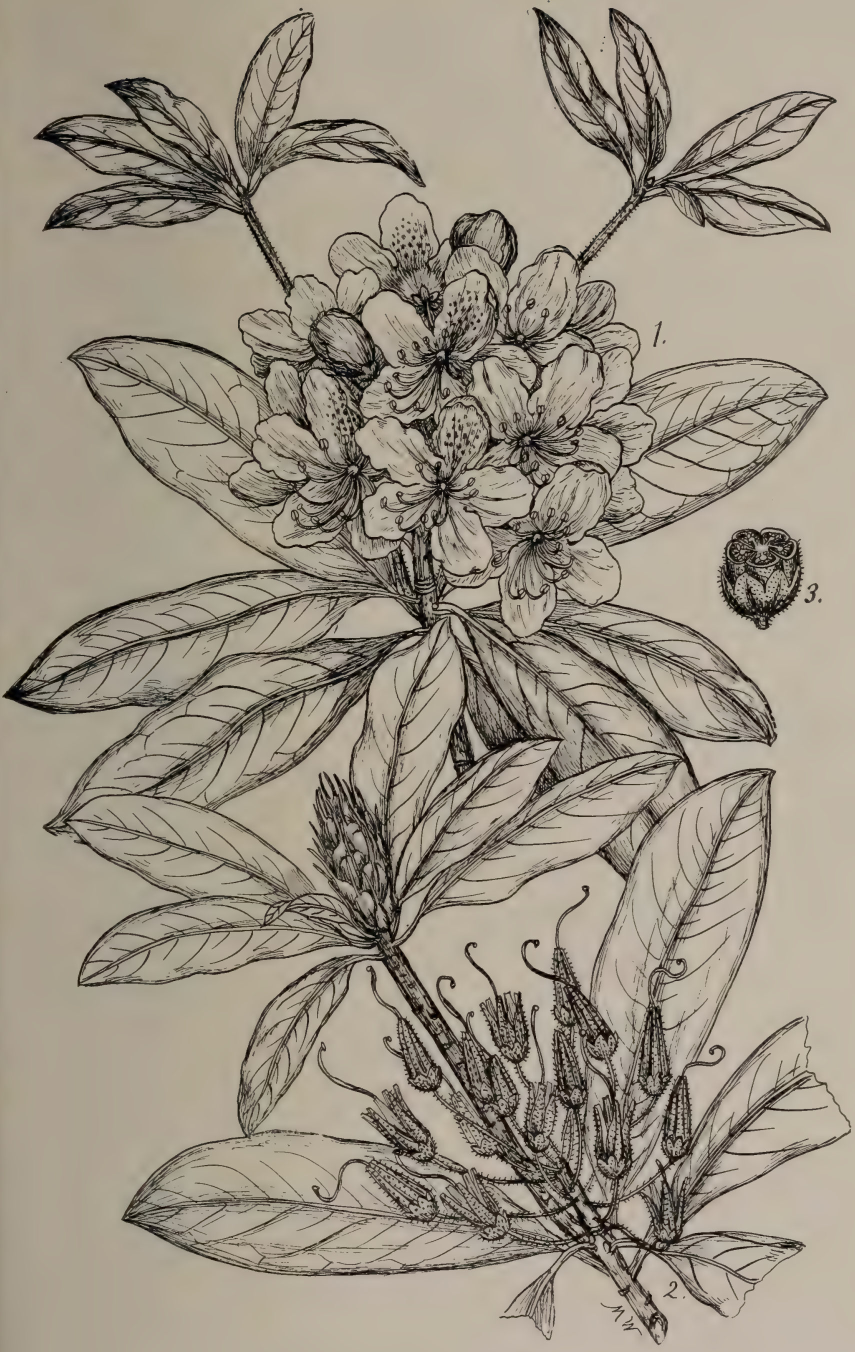

PLATE CXX. GREAT LAUREL.

1. Branch with mature and immature leaves, and a cluster of open flowers, x ½.
2. A fruiting branch with a large terminal bud, x ½.
3. Cross-section of a fruit capsule showing five cells, natural size.

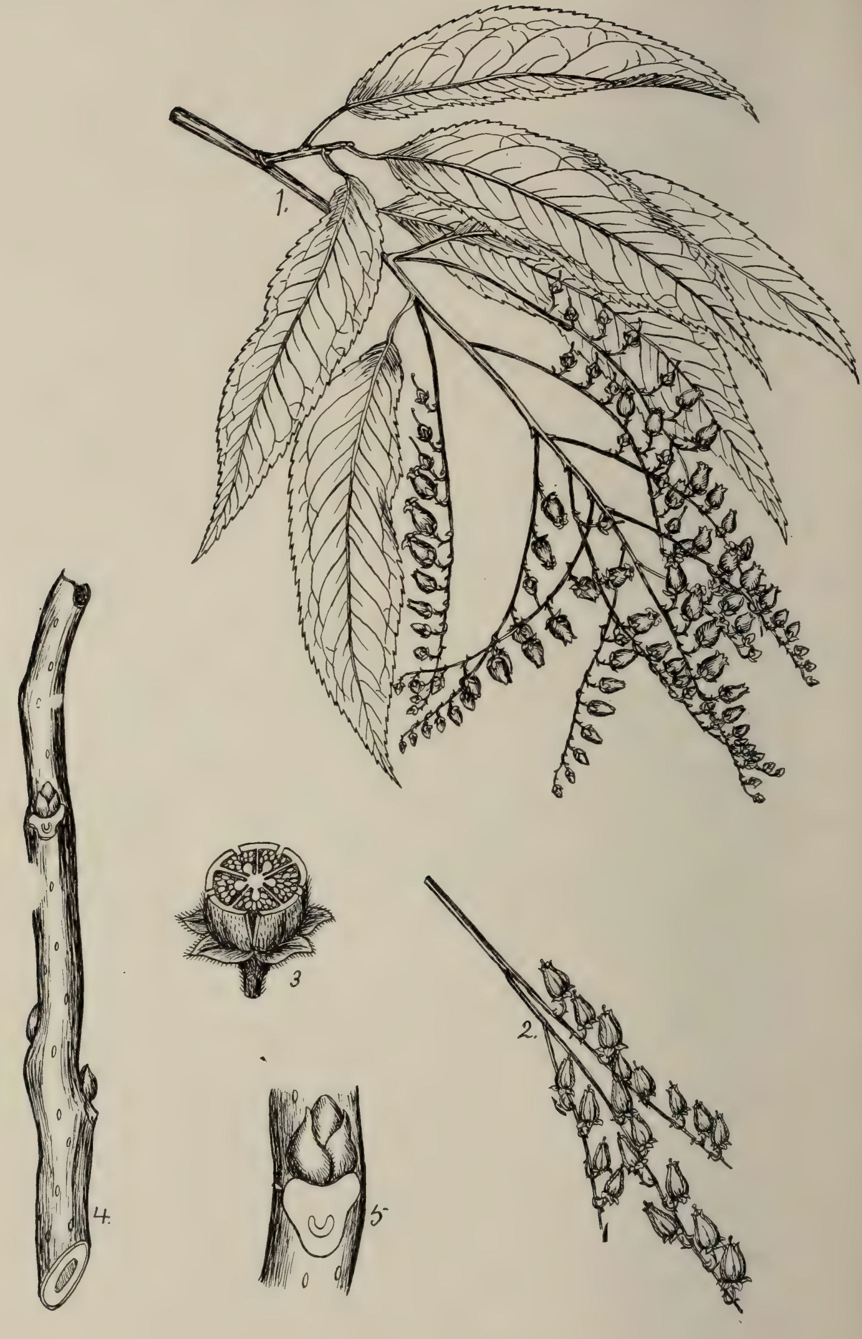

PLATE CXXI. SOUR-WOOD.

1. A flowering branch with long one-sided racemes of flowers clustered in an open panicle, x ½.
2. A few racemes of fruit, x ½.
3. Cross-section of a capsule showing five cells filled with seeds, slightly enlarged.
4. A winter twig, enlarged.
5. Section of a winter twig, enlarged.

SOUR-WOOD.

Oxydendrum arboreum, (Linnaeus) De Candolle.

GENUS DESCRIPTION—The Sour-wood is the sole representative of the genus Oxydendrum. The word Oxydendrum means acid tree, in allusion to the acid foliage.

FORM—A medium-sized tree which may reach a height of 50-60 ft. with a diameter of 20 inches, but usually is about 25 ft. in height with a diameter of 8 inches. Trunk usually straight, tall, slender, and bears a narrow round-topped crown.

BARK—Rather thick, roughened by fissures which separate rounded ridges covered with thick scales. On old trunks grayish often tinged with red; on young branches reddish-brown.

TWIGS—Rather slender, at first yellowish-green, later orange-colored and reddish-brown. Marked with numerous, oblong, elevated lenticels.

BUDS—Alternate, axillary; terminal buds absent; small, partly imbedded in the bark, acute at apex, covered with several opposite dark red scales.

LEAVES—Alternate, simple, oblong, stalked, acute at apex, wedge-shaped at base, serrate on margin, very smooth, 5-7 inches long, 1½-2½ inches wide.

LEAF-SCARS—Alternate, elevated, nearly triangular, with a single compounded bundle-scar.

FLOWERS—Appear about July. White, perfect, with cylindrical corolla, and borne in racemes often 6-8 inches long.

FRUIT—A 5-sided, 5-valved capsule terminated by a persistent style. Matures in September only a month or six weeks after the flowers. Capsules often persist in clusters.

WOOD—Diffuse-porous; hard, heavy, compact, reddish-brown with lighter sapwood. Medullary rays are numerous but narrow. Weighs 46.48 lbs. per cubic foot. Used locally for runners of the Appalachian tanbark sleds, and for tool handles.

DISTINGUISHING CHARACTERISTICS—The Sour-wood, also known as Sorrel-tree and Sour Gum, can be distinguished in summer by its white bell-shaped flowers which are arranged in racemes resembling the lily-of-the-valley. The alternate bitter leaves which resemble the peach leaf are also characteristic. The bark on older trees resembles that of the Black Gum. The winter buds, which are dark red, alternate, very small, often partly inbedded by bark, are also characteristic.

RANGE—Pennsylvania and Indiana south to Florida and western Louisiana.

DISTRIBUTION IN PENNSYLVANIA—Found only sparsely in the southeastern part of the State.

HABITAT—Usually frequents well-drained soils. Commonly found on hillsides, seldom along streams.

IMPORTANCE OF THE SPECIES—The Sour-wood is native only to a very small portion of southern Pennsylvania. Its small size and limited distribution in this State prevent it from being recommended for forestry purposes. It is, however, an attractive ornamental tree on account of its form, late flowering, beautiful and attractive autumnal foliage.

COMMON PERSIMMON.

Diospyros virginiana, Linnaeus.

FAMILY AND GENUS DESCRIPTION—The Ebony family, Ebenaceae, is widely distributed in the tropics, and only a few representatives are found in the temperate regions. It comprises about 6 genera with more than 250 species. The most important genus is Diospyros which has 2 representatives in the flora of the United States and 1 in Pennsylvania. This genus comprises about 160 species found mostly in the tropics. Members of this genus produce some of the ebony of commerce, and valuable foods in China and Japan. The species described below is the sole representative of this genus in eastern North America. One other species is found in the southern and western parts of Texas.

FORM—A small tree usually from 25 to 50 ft. in height with a diameter of less than 12 inches, but may reach a height of 100 ft. with a diameter of 2 feet. Trunk usually short and slender. Crown high and broad-topped. It often spreads by roots migrating under the ground, forming dense thickets.

BARK—On old trunks thick, hard, dark gray to dark brown or black, cinnamon-red at the bottom of the fissures; separates into thick squarish blocks which peel off into thin scales. See Fig. 101.

TWIGS—Slender, bitter, astringent, grayish to reddish-brown becoming darker in second year, usually pale pubescent, covered with a few scattered orange-colored lenticels, and contain large pith or pith chamber.

BUDS—Alternate, broadly ovate, closely pressed against twig, ⅛ of an inch long, sharp-pointed, covered by 2 dark brown glossy scales; terminal bud absent.

LEAVES—Alternate, simple, oval, acute at apex, entire on margin, wedge-shaped to heart-shaped at base, 4-6 inches long, thick, dark green and shiny above, often hairy below. Leaf-stalks are ½-1 inch long, and contain 1 fibro-vascular bundle.

LEAF-SCARS—Alternate, elevated, flattened, contain 1 prominent bundle-scar which is transversely-elongated, or several becoming confluent.

FLOWERS—White, appearing about May or June. Staminate and pistillate flowers occur separate. Staminate arranged in 2-3-flowered cymes. Pistillate solitary, and borne on short stalks.

FRUIT—A juicy, spherical, orange-colored, often red-cheeked berry with remnants of style persisting and seated in enlarged green calyx. Often very astringent. Sometimes edible before frost appears. Contains from 1-8 seeds, usually 4-6.

WOOD—Diffuse-porous; heavy, hard, compact, susceptible to a high polish, strong; heartwood is brown to black but usually forms late; sapwood is wide, yellowish and often streaked with black. Weighs about 49 lbs. per cubic foot. Used for shuttles, gold heads, billiard cues, mallets, parquet flooring, brush backs, veneer.

DISTINGUISHING CHARACTERISTICS—The Persimmon, also known as Date-plum and Possum-wood, can be distinguished in summer by its alternate, simple, entire-margined, deep green leaves with only 1 fibro-vascular bundle in the leaf-stalk and the rough bark which is often broken up into quadrangular blocks and is evidently cinnamon-red at the base of the fissures. In autumn the fruit is characteristic. In winter the rough bark with cinnamon-red color at the bottom of the fissure, the semi-orbicular leaf-scars with only 1 bundle-scar, the broadly ovate buds with 2 dark brown scales, the reddish-brown slightly pubescent twigs with relatively large pith or pith cavity, and the persistent remnants of flowers are distinctive.

RANGE—Connecticut to Florida, westward to Iowa and Texas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts of the State. Abundant on Gettysburg battlefield. Local in southwestern part of the State. Absent in the higher mountainous parts.

HABITAT—Prefers a light, somewhat sandy well-drained soil. Tolerates rich bottomlands especially in the South.

IMPORTANCE OF THE SPECIES—The Persimmon is too small in size and too limited in distribution in this State to be of commercial importance from the point of view of wood production. It is essentially a southern tree. The tree has an attractive form, beautiful clean foliage, and an exceptionally attractive bark. It rarely exceeds 40 feet in height with a diameter of 12 inches in this State.

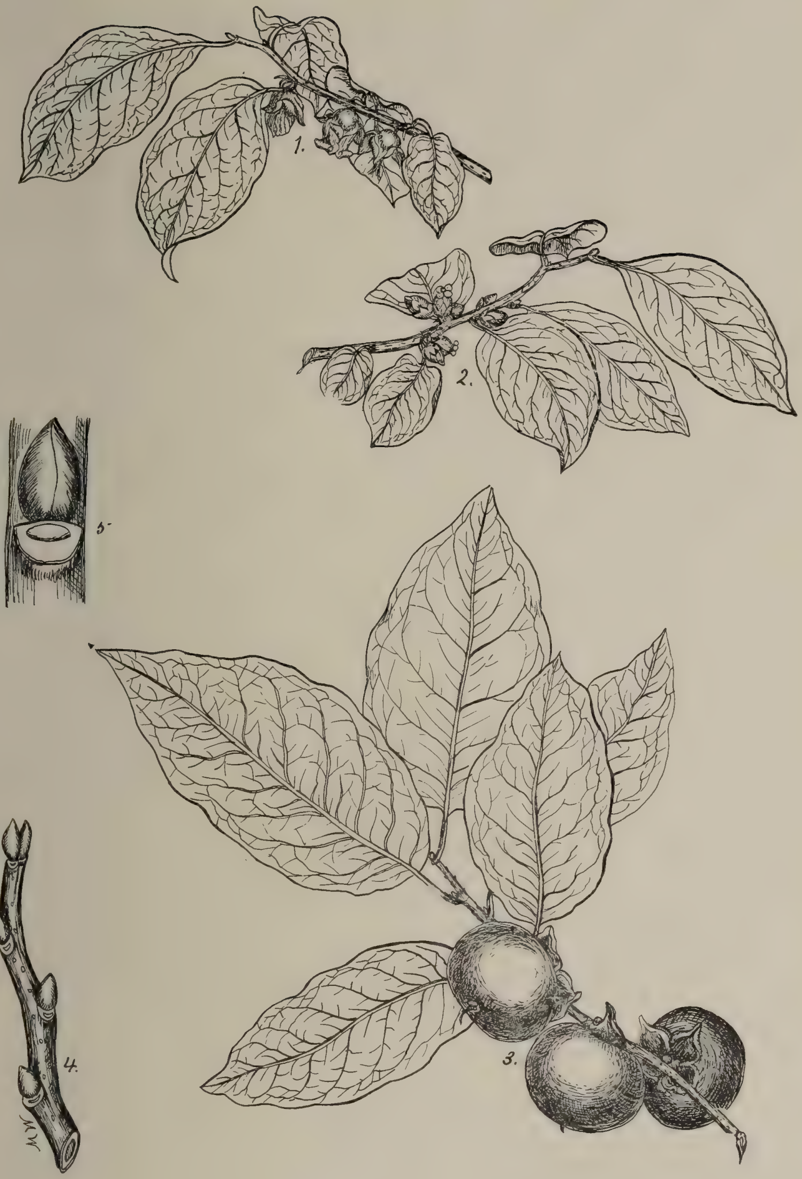

PLATE CXXII. COMMON PERSIMMON.

1. A branch with pistillate flowers, x ½.
2. A branch with staminate flowers, x ½.
3. A fruiting branch with mature leaves, x ½.
4. A winter twig, natural size.
5. Section of a winter twig, enlarged.

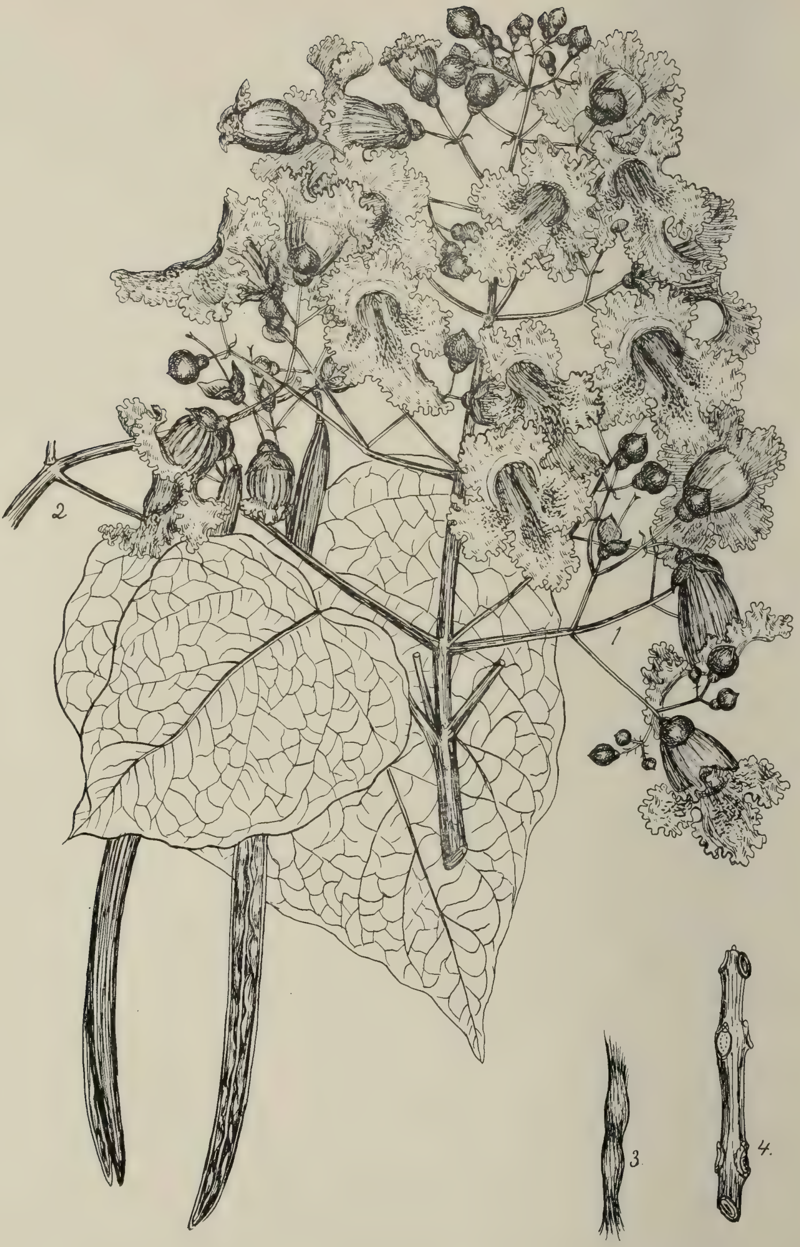

PLATE CXXIII. CATALPA.

1. A panicle of flowers, x ½.
2. A branch with two drooping cigar-like fruits, the one split open showing the seeds, x ½.
3. A winged seed, x ½.
4. A winter twig, x ½. See Plate II.

CATALPA.

Catalpa bignonioides, Walter.

FAMILY AND GENUS DESCRIPTION—This tree belongs to the Bignonia family, Bignoniaceae, which comprises about 100 genera with 1,500 species. Most of the representatives of this family occur in the tropics; only a few are found in the temperate zone. They occur as trees, shrubs, woody climbers, or rarely herbs. North America has only 6 genera with 8 species in its flora and Pennsylvania 3 genera with 3 species. The genus Catalpa is the only one which has tree representatives occuring rather frequently in this State. This genus comprises about 7 species in the world, of which number 2 are native to North America. No representative of this genus is native to Pennsylvania but 1 species has been naturalized so extensively in every part of the State, that a description of it in this publication was considered desirable.

FORM—Usually 25-40 ft. high but may reach a height of 60 ft., with a diameter of 3 feet. Trunk usually short, crooked, often angular, and unattractive. Crown high, broad, and rather symmetrical in appearance in summer, due to the dense foliage.

BARK—Light brown, rather thin, shallowly-ridged, scaly, bitter.

TWIGS—Stout, smooth, or slightly downy, yellowish-brown, usually frozen back, covered with numerous large lenticels, roughened by leaf-scars. Pith large, white sometimes chambered at the nodes. See Plate II, 2.

BUDS—Terminal bud usually absent. Lateral buds small, almost inbedded in bark, usually less than ⅛ of an inch long, covered with 5-6 visible, small, brown bud-scales.

LEAVES—Opposite or whorled i. e., more than two at a node, simple, 6-10 inches long, 4-5 inches broad, ovate, heart-shaped at base, acute at apex, entire or wavy on margin. Fall simultaneously after first heavy frost.

LEAF-SCARS—Opposite or 3 at a node, large, conspicuous, with projecting margin, elliptical in outline, with conspicuous bundle-scars usually arranged in an ellipse.

FLOWERS—Appear in June or July. Perfect, arranged in many-flowered crowded panicles from 8-10 inches long. Corolla is conspicuously spotted on inner surface.

FRUIT—A long, cylindrical, bean-like capsule which often persists far into winter and contains many flattened winged seeds. Wings surround seeds and are fringed at ends. Tree is sometimes called Indian Bean on account of fruit.

WOOD—Ring-porous; distinct demarcation between heartwood and sapwood; odor somewhat like kerosene; light, soft, coarse-grained; durable in contact with soil, light brown, and has a satiny surface. Weighs about 26 lbs. per cubic foot. Used mainly for cross-ties, posts and poles.

DISTINGUISHING CHARACTERISTICS—The Eastern Catalpa, also known as Catalpa, Indian Bean, and Cigar Tree, can be distinguished in summer by its leaves which are opposite or whorled and its large panicles of flowers. The cigar-like or bean-like fruit is characteristic in autumn and winter. In winter it can be distinguished by its large elliptical leaf-scars which are opposite or whorled and have their bundle-scars arranged in an ellipse. The pith is sometimes chambered at the nodes. The Eastern Catalpa closely resembles the Western Catalpa but has slenderer and thinner walled fruit, larger flower-clusters, more distinct markings on inner surface of corolla, and more blunt-pointed leaves. The Western Catalpa is more frost hardy than the Eastern Catalpa.

RANGE—Original range was limited to parts of Georgia, Alabama, Mississippi and Florida. At present found in all parts of the country east of the Rocky Mountains and as far North as New England.

DISTRIBUTION IN PENNSYLVANIA—Planted for ornamental purposes in many parts of the State and has escaped cultivation in practically every part of the State. Individual specimens or small groups of trees are common in the forest near settlements.

HABITAT—Prefers moist and fertile situations, is most common along streams and river banks, but also found in drier places. Prefers shaded to open situations.

IMPORTANCE OF THE SPECIES—Two species of Catalpa are commonly recognized, the Eastern Catalpa and the Western or Hardy Catalpa. Both have been widely advertised. The Western species is hardier against frost and produces a straighter and cleaner trunk. Neither of the 2 species should be planted for forestry purposes in this State. Both species produce beautiful flowers and foliage and attractive fruit.

THE OLIVE FAMILY—OLEACEAE.

The Olive family comprises representatives which are widely distributed in temperate and tropical regions, but are commonest in the northern portion of both hemispheres. A great variety of trees and shrubs is embraced by this family, some of which are valuable timber trees, while others are valuable for ornamental purposes or for the food which they yield. The most important is the Olive Tree (Olea Europaea, L.), whose fruit and the oil derived from it are used almost universally as food. The Olive Tree was cultivated in ancient times in Syria and Palestine; later it was introduced into the Mediterranean region, where one can find large orchards of it at the present time; and within the past few decades it has been introduced on a large scale into the southwestern part of the United States. A few specimens are also growing at the present time near Mont Alto, Pennsylvania. The Ashes which are among our most valuable timber trees, the Forsythias and Lilacs which are among our most attractive and popular shrubs, and the Privets, which are used so extensively as hedge plants, are also members of this family.

The Olive family comprises about 21 genera with 500 species of trees, shrubs, and a few herbs. The flora of North America contains 5 genera with about 20 species, while that of Pennsylvania contains 4 genera with 9 species. Only 2 of the 4 genera native to Pennsylvania have tree representatives.

KEY TO THE GENERA.

	Page.
1. Leaves compound; fruit a dry samara; flowers without a corolla; winter buds with 3-4 pairs of scales, ... Fraxinus	213
1. Leaves simple; fruit a fleshy berry; flowers with a corolla; winter buds with more than 4 pairs of scales, ... Chionanthus	217

THE ASHES—FRAXINUS, (Tourn.) L.

The Ashes with one or two exceptions are trees, which occupy a variety of situations but prefer rich, moist soil. Some species may also be found occasionally in swamps or along streams, while others frequent dry and poor uplands. The trees are usually straight, have little stem taper, and often attain large dimensions. They are, locally, rather abundant and yield wood which is straight-grained, strong, and elastic. The wood of all the eastern species except that of the Black Ash, is sold as White Ash. This classification is legitimate since there is little difference for practical purposes. They are also valuable as shade trees. Our native species and the introduced European species (Fraxinus excelsior, L.) are planted rather extensively in parks and lawns. The trunk and leaves of Fraxinus ornus, L., a species of southern Europe and Asia Minor, yield the manna of commerce.

The Ashes may be regenerated by natural and artificial methods. The natural regeneration may be accomplished by means of regulated cutting of the mature trees accompanied by the establishment of a young growth from the seed scattered by the seed trees which remain, or by means of coppicing. Coppicing is a practical method of regeneration especially on rich, moist soils and where very large sizes are not required. The artificial regeneration may be accomplished by sowing seeds, or what is still better, by collecting the seeds, planting them in the nursery, and after a year's growth in the nursery, lifting them and planting them out upon the area where they are to remain and produce a timber crop.

The leaves of the Ashes are opposite and compound. The leaflets occur in 2s opposite each other along the principal leaf-stalk with a single leaflet at the end, hence the total number of leaflets is always odd. The twigs are stout and occur in pairs opposite each other along the main axis. The branchlets are usually flattened at the nodes. The flowers are produced in dense clusters and usually appear in spring before the leaves have made their appearance. The fruit, known as a samara, matures in fall and occurs in clusters. The individual seed is winged at one end. This wing aids in the dispersal of the seed by the wind, which is the most important dispersing agent; but water may also scatter a large quantity of the seeds, especially of such species which are commonest near streams or where flood waters occur.

The Ashes are distributed throughout the north temperate zone and comprise about 40 known species, of which number 16 occur in North America and 4 in Pennsylvania. Three species are common in this State, while another species known as the Biltmore Ash (Fraxinus Biltmoreana, Beadle), is found locally only over a limited region in the southern part of the State. A variety of the Red Ash known as the Green Ash (Fraxinus pennsylvanica var. lanceolata) is also found locally in the southern part of the State.

SUMMER KEY TO THE SPECIES.

Page.

1. Leaves with sessile leaflets; seed surrounded by wing; bark scaly, not furrowed with diamond-shaped fissures, ... F. nigra 215
1. Leaves with stalked leaflets: seed partly surrounded by wing; bark furrowed with diamond-shaped fissures, ... 2

2. Leaves and twigs smooth or nearly so; seed usually winged only at apex, ... F. americana 214
2. Leaves and twigs velvety pubescent; seed winged usually at apex and sides, F. pennsylvanica 216

WINTER KEY TO THE SPECIES.

1. Buds usually black and acute at apex; bark scaly, not furrowed with diamond-shaped fissures; tall and slender, ... F. nigra 215
1. Buds rusty to dark brown, usually obtuse at apex; bark furrowed with diamond-shaped fissures; tall but stout, ... 2

2. Twigs smooth or nearly so; leaf-scars evidently indented on upper margin, ... F. americana 214
2. Twigs velvety pubescent; leaf-scars not evidently indented on upper surface, ... F. pennsylvanica 216

WHITE ASH.

Fraxinus americana, Linnaeus.

FORM—Usually reaches a height of 70-80 ft. with a diameter of 2-3 ft., but may attain a height of 120 ft. with a diameter of 5-6 ft. Trunk usually tall, massive, clear from branches for a considerable distance from the ground when grown in the forest, bearing a narrow, somewhat pyramidal crown. When open grown the crown is decidedly round-topped and often extends almost to the ground. In forest grown trees trunk often continuous and dividing into a number of spreading branches.

BARK—Grayish-brown, rather thick upon older trunks, decidedly divided by diamond-shaped fissures into rather flattened ridges which are covered by thin, close-fitting scales. Longitudinal ridges often transversely-fissured so that the primary fissures are connected. See Fig. 86.

TWIGS—Opposite, stout, usually smooth, sometimes covered with a slight bloom, decidedly flattened at the nodes. During the first winter grayish-brown in color, and decidedly lustrous; covered by scattered, large, pale lenticels.

BUDS—Opposite, ovate, blunt-pointed, usually dark brown, occasionally almost black. Terminal bud larger than laterals, covered by 2-3 pairs of visible scales which occur opposite each other. Scales on the terminal buds may be somewhat sharp-pointed, while those on the lateral buds are usually obtuse. Two lateral buds are usually found at base of terminal bud causing a terminal enlargement of twig.

LEAVES—Opposite, compound, about 10 inches long with 5-9 leaflets. Leaflets 3-5 inches long, about 1½ inches broad, evidently-stalked, slightly serrate on margin, acute at apex, wedge-shaped to rounded at base. When full grown usually smooth and dark green above and pale below. A few hairs are sometimes found along the veins on the lower surface.

LEAF-SCARS—Opposite, semi-circular in outline, notched on the upper margin, raised, conspicuous; bundle-scars small, numerous, arranged in a curved line.

FLOWERS—Appear about May before the leaves. The staminate and pistillate on different trees. Staminate occur in dense reddish-purple clusters; pistillate in rather open panicles.

FRUIT—A samara borne in dense drooping panicles about 7 inches long. Panicles often persist far into winter. Individual samara 1-2 inches long, consists of a seed bearing portion and a winged portion. Seed portion round in cross-section, terminated by the wing which aids in the dispersal of the seed. Since some trees bear staminate flowers only, seeds are never found upon them. Trees bearing pistillate flowers alone produce seeds.

WOOD—Ring-porous; very heavy and strong, odorless and tasteless, tough, elastic, and brown, with thick and much lighter colored sapwood. Pores in spring wood large, usually 3-10 rows wide. Pores in summer wood isolated or in groups of 2-3, and usually joined by wood parenchyma. Weighs 40.77 lbs. per cubic foot. Used in the manufacture of agricultural implements, wagon building, furniture, interior finishing of houses, and for tool handles.

DISTINGUISHING CHARACTERISTICS—The White Ash, also known as the Canadian Ash, can be distinguished from the Black Ash by its leaves, which have stalked leaflets, while the leaflets of the Black Ash are sessile. The buds of the White Ash are usually obtuse and brown in color, while those of the Black Ash are usually acute and black in color. The bark of the White Ash is usually furrowed and has diamond-shaped fissures between the ridges, while the bark of the Black Ash is scaly, often corky and not furrowed. It can be distinguished from the Red Ash by its smooth leaves and twigs. Those of the Red Ash are usually velvety-pubescent. The leaf-scars of the White Ash are usually evidently-indented in the upper margin, while those of the Red Ash are not. The seeds of the White Ash have wings which are fastened only to the apex of the seed, while in the Red Ash they are fastened to the apex and often extend down along the sides, and in the Black Ash the wing usually surrounds the seed.

RANGE—Nova Scotia to Minnesota and southward to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Generally distributed throughout the State. Common in the eastern, southern, and western parts. Sparse in the mountainous parts, except in moist valleys and rich bottomlands.

HABITAT—Prefers fertile, moist soils; very common in rich, moist woods and along streams, lakes, and other bodies of water. Occasionally found on rather dry hillsides.

IMPORTANCE OF THE SPECIES—The White Ash is one of the most important timber trees of Pennsylvania on account of the large size which it attains, its general distribution throughout the State, its rapid growth, as well as its immunity from the attack of fungous diseases and insects. Nature did not produce it in pure stands, hence in developing our future forests we should aim to follow nature and plant White Ash in mixture with some other desirable species. White Ash and White Pine will undoubtedly prove to be a valuable mixture.

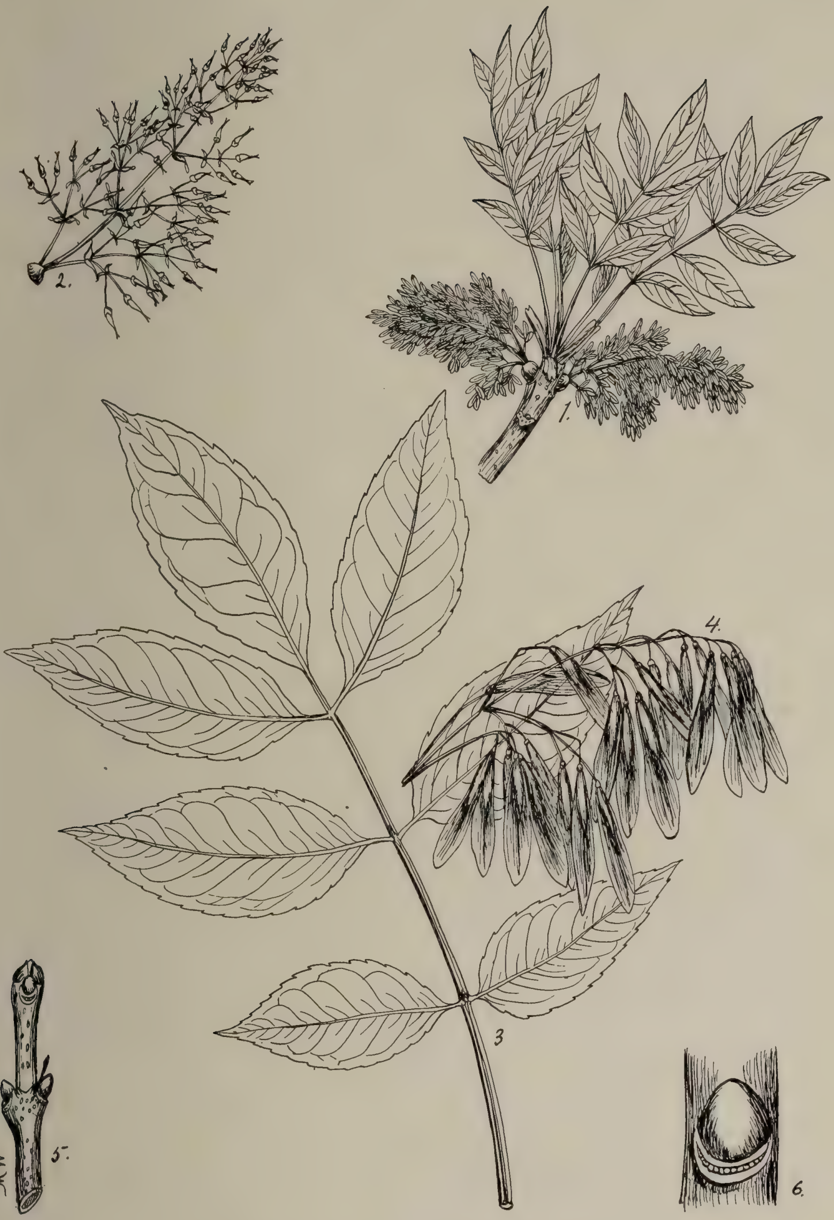

PLATE CXXIV. WHITE ASH.

1. A branch with a cluster of staminate flowers and immature leaves, x ½.
2. A panicle of pistillate flowers, x ½.
3. A mature compound leaf, x ½.
4. A cluster of fruit, x ½.
5. A winter twig, x ½.
6. Section of a winter twig, enlarged.

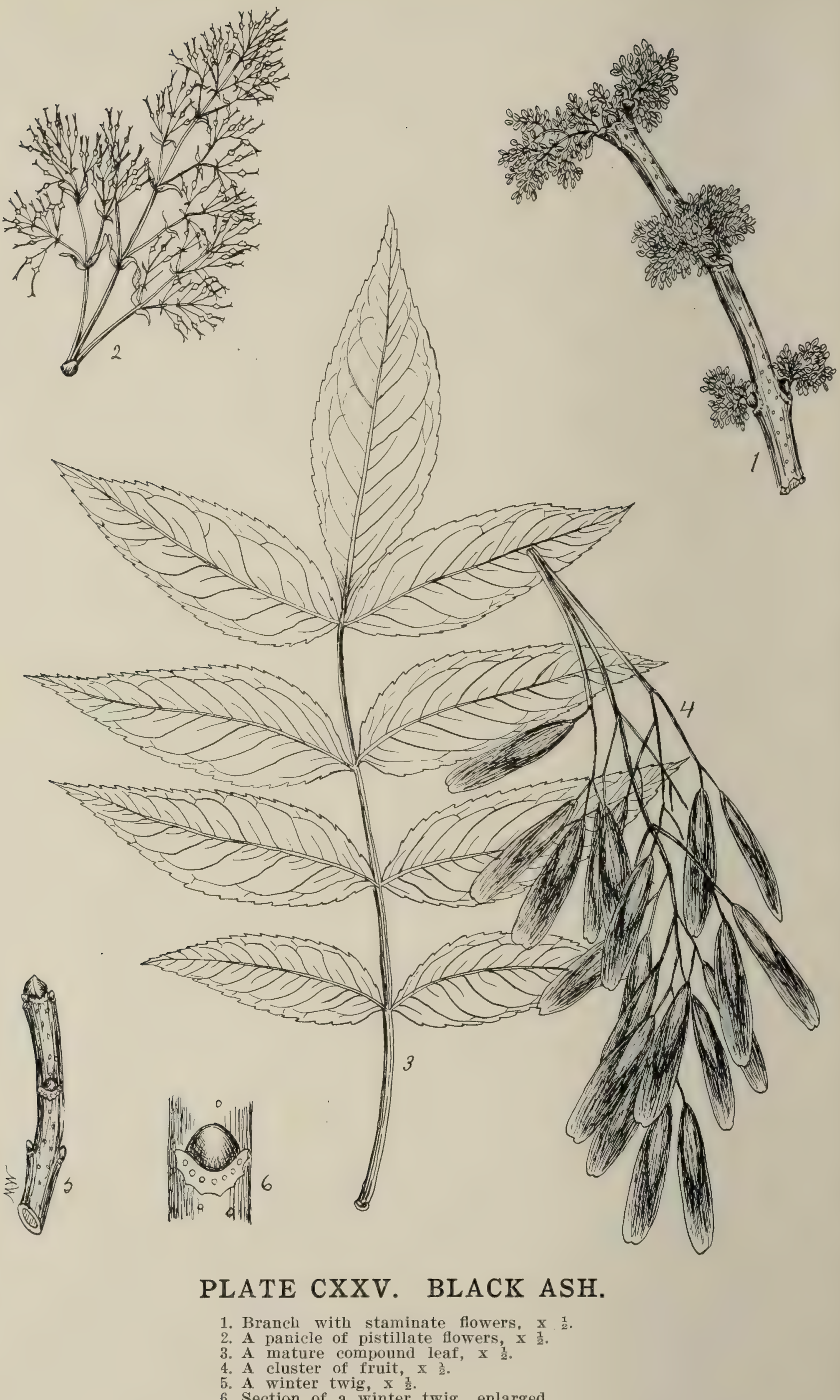

PLATE CXXV. BLACK ASH.

1. Branch with staminate flowers, x $\frac{1}{2}$.
2. A panicle of pistillate flowers, x $\frac{1}{2}$.
3. A mature compound leaf, x $\frac{1}{2}$.
4. A cluster of fruit, x $\frac{1}{2}$.
5. A winter twig, x $\frac{1}{2}$.
6. Section of a winter twig, enlarged.

BLACK ASH.

Fraxinus nigra, Marshall.

FORM—A medium-sized tree which usually attains a height of 60-80 ft. with a diameter of 1-2 ft., but may reach a height of 100 ft. with a diameter of 2½ feet. It usually has a rather tall, slender trunk often free from branches for a considerable distance from the ground bearing a narrow and shallow crown formed by numerous rather upright branches. Usually found in the forest, where the slender form prevails, but occasionally may be found in the open, where its form resembles that of the White Ash.

BARK—Thin, grayish, shallowly and irregularly fissured; ridges between the fissures decidedly scaly and somewhat corky. By rubbing the bark it breaks up into a very fine powder. See Fig. 87.

TWIGS—Rather stout, at first somewhat hairy, but soon becoming quite smooth. Resemble those of the White Ash but lighter in color, and not so smooth and glossy.

BUDS—Opposite; terminal bud present, ovate, sharp-pointed, black, covered with 1-2 pairs of visible bud-scales, usually at some distance from nearest lateral buds; lateral buds usually almost as broad as long, often obtuse at apex, closely oppressed to twigs.

LEAVES—Opposite, compound, about 14 inches long, with 7-11 sessile leaflets. Leaflets are all sessile except the terminal one, 3-5 inches long, about 1½ inches wide, acute at the apex, serrate on the margin, wedge-shaped at the base, dark green and smooth above, paler below.

LEAF-SCARS—Opposite, large, conspicuous, crescent-shaped, upper margin usually straight or convex; bundle-scars numerous arranged in a curved line, sometimes joined so as to form a compound scar.

FLOWERS—Appear about May before the leaves. Staminate and pistillate borne on the same or different trees; the staminate in dense, dark purplish clusters; the pistillate in rather open panicles.

FRUIT—A samara which resembles the fruit of the White and Red Ashes, but differs in that the wing is broader, decidedly notched at the apex, and completely surrounds the somewhat flattened seed bearing portion.

WOOD—Ring-porous; heavy, smooth, soft, not strong, rather coarse grained, somewhat durable. Heartwood dark brown with white sapwood; marked difference between spring and summer wood; annual layers of the wood easily separated. Pores in spring wood in a broad zone often comprising one-half of the ring. Pores in summer wood large, few, scattered. Weighs 39.37 lbs. per cubic foot. Used in the manufacture of baskets, hoops, chair bottoms, and the interior finishing of houses.

DISTINGUISHING CHARACTERISTICS—The Black Ash, also known as Hoop, Swamp, Basket, and Brown Ash, can readily be distinguished from all the other species of Ash in Pennsylvania in summer by its opposite and compound leaves with sessile leaflets. The leaflets of all other species of Ashes are evidently-stalked. In winter it can be recognized by its black and acute buds, its scaly, non-fissured bark, and its tall and slender form. In autumn by its fruit with a flattish body which passes insensibly into the wing.

RANGE—Newfoundland to Manitoba, south to Virginia and Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Generally distributed over the State. Common in the eastern, southern, central and western parts. Rare in mountainous portion except in moist valleys.

HABITAT—Prefers swampy habitats, in this respect differing very much from the other species of Ash native to the State. Flourishes best in the cooler portions of its range. Seldom thrives on dry ground.

IMPORTANCE OF THE SPECIES—This species has probably never been grown for forestry purposes. It may be so recommended where natural reproduction may be depended upon and in such locations where other more valuable trees will not grow. Few better species grow in its chosen home and consequently it may be one which we will plant in the future in extremely wet locations together with others such as Spruce, Fir, and Larch.

RED ASH.

Fraxinus pennsylvanica, Marshall.

FORM—Tree of middle or large size, usually attaining a height of 30-60 ft. with a diameter of 1-3 ft., but may reach a height of 70 ft. with a diameter of 5 feet. Trunk similar to that of White Ash, but smaller and bearing numerous upright branches which form a rather irregular and compact crown.

BARK—Grayish-brown, roughened by numerous fissures separating prominent ridges which in time become scaly. Fissures usually diamond-shaped. Ridges often sub-divided by transverse secondary fissures.

TWIGS—Similar to those of the White Ash but not so stout and covered with a dense velvety pubescence, or sometimes almost smooth. See "Twigs" under White Ash, page 214.

BUDS—Opposite; terminal bud present; ovate, brown, covered by brownish scales, 2 pairs of which are usually visible. Scales of the lateral buds usually have an obtuse apex while those of the terminal buds have a more acute apex. See "Buds" under White Ash, page 214.

LEAVES—Opposite, compound, about 11 inches long, with 5-9 stalked leaflets. Leaflets from 3-5 inches long, 1-1½ inches wide, ovate, acute at apex, slightly toothed on margin, wedge-shaped at base. At first coated on the lower surface with white tomentum, later becoming yellowish-green above, and decidedly velvety-pubescent beneath.

LEAF-SCARS—Opposite; semi-circular in outline, conspicuous, slightly notched on the upper margin; bundle-scars numerous, usually small, and arranged in a curved line. Sometimes a number of bundle-scars unite to form a compound bundle-scar.

FLOWERS—Appear about May before or with the leaves. Staminate and pistillate are usually borne on different trees. Staminate occur in dense purplish-red clusters; pistillate in open greenish-red panicles.

FRUIT—A samara, borne in open panicles which often persist far into winter. The individual samara varies in length from 1-2 inches, and consists of a seed bearing portion and a winged portion. Fruit resembles that of the White Ash, but has the winged portion attached not only to the apex of the seed but also along the sides, while the White Ash has the wing attached at the apex only.

WOOD—Ring-porous; heavy, hard, rather strong, light brown, with rather wide and light colored sapwood. Pores in the spring and summer wood are similar to those of the White Ash, but the lines of pores in the summer wood are longer than in the White Ash. Weighs 44.35 lbs. per cubic foot. Used for the same purposes as the White Ash, but is somewhat inferior to it from a commercial point of view.

DISTINGUISHING CHARACTERISTICS—The Red Ash can be distinguished at any season of the year from the other species of Ash native to Pennsylvania by its velvety-pubescent twigs and petioles. In addition it can be distinguished from the White Ash by its fruit, the wings of which are attached to the apex and the sides of the seeds, while those of the White Ash are attached at the apex only. The leaflets of the Red Ash are decidedly stalked while those of the Black Ash are sessile. The buds of the Red Ash are brown in color and usually obtuse, while those of the Black Ash are black in color and usually acute. The bark of the Red Ash is prominently-fissured while that of the Black Ash is not fissured but decidedly scaly and presents somewhat of a corky appearance.

RANGE—Vermont west to Minnesota and southward to Florida and Texas.

DISTRIBUTION IN PENNSYLVANIA—Found in the eastern and southern parts of the State. Not known to occur in other parts.

HABITAT—Prefers rich soil in valleys; also found in swampy lowlands and along the margins of streams, lakes, and ponds; occasionally found upon rather dry hillsides.

IMPORTANCE OF THE SPECIES—The Red Ash in many respects resembles the White Ash, but it is of less economic importance since it does not attain so large a size as the White Ash, its wood is not quite so valuable, and it requires a somewhat moister soil. The White Ash will grow in all places where the Red Ash thrives, and consequently the White Ash should be favored. It is sometimes planted for ornamental purposes but the White Ash is generally regarded more attractive and just as free from the attacks of insects and fungi. The only place where the Red Ash could be recommended for planting for forestry purposes would be in such situations where it is too wet for the White Ash to thrive.

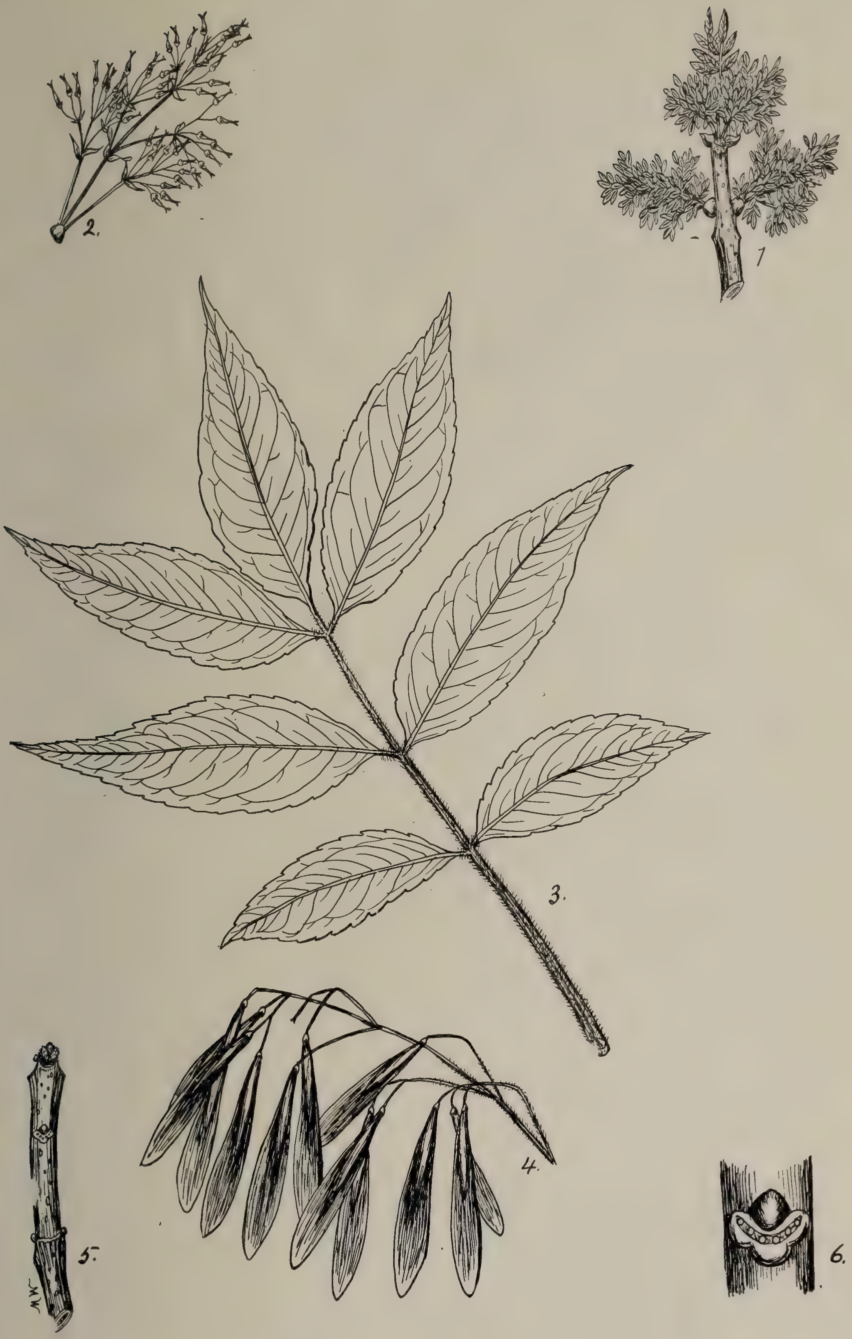

PLATE CXXVI. RED ASH.

1. Branch with staminate flowers, x ½.
2. A panicle of pistillate flowers, x ½.
3. A mature compound leaf, x ½.
4. A cluster of fruit, x ½.
5. A winter twig, x ½.
6. Section of a winter twig, enlarged.

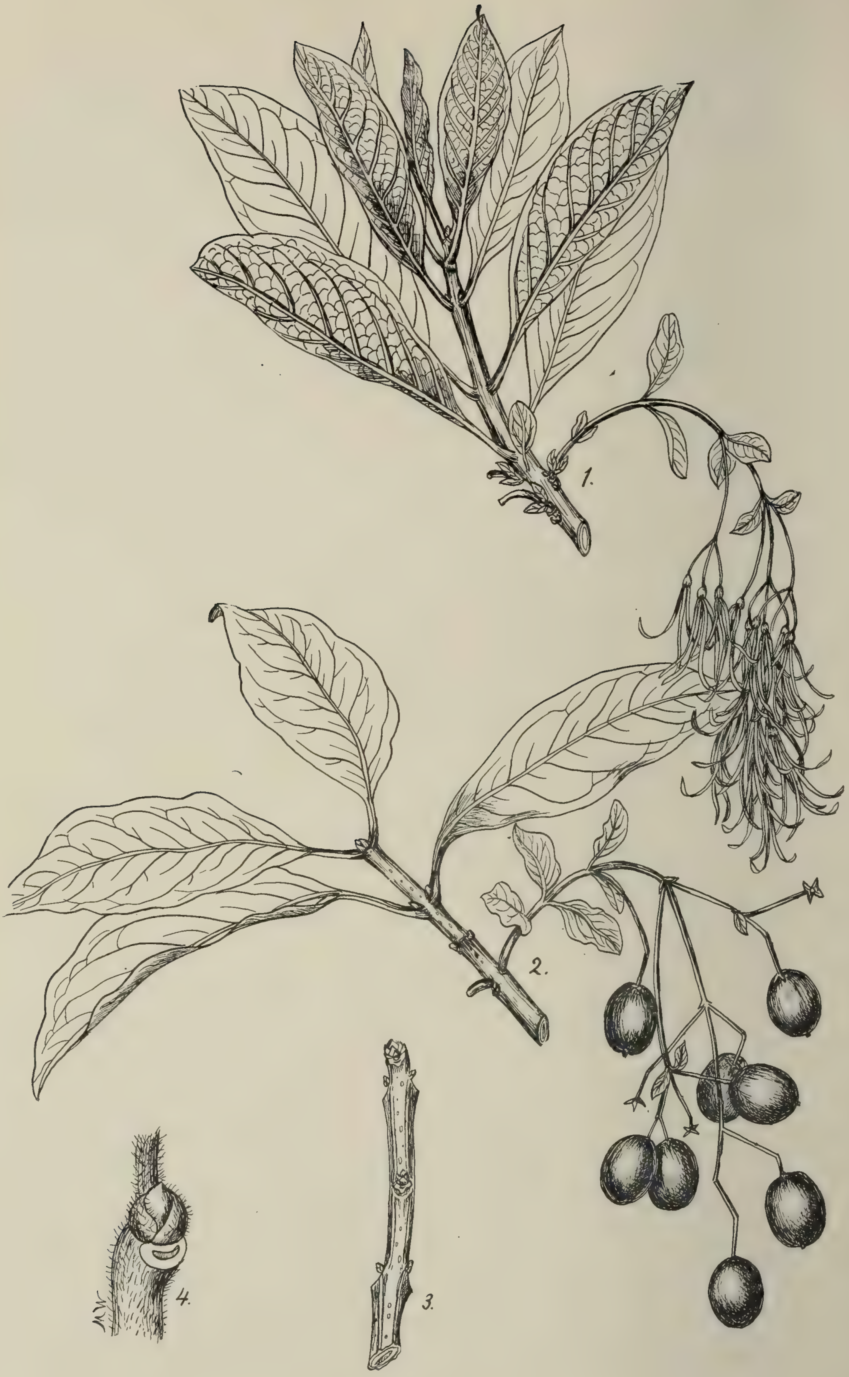

PLATE CXXVII. FRINGE-TREE.

1. A flowering branch with immature leaves, x ½
2. A fruiting branch with mature leaves, x ½.
3. A winter twig, x ½.
4. Section of a winter twig, natural size.

FRINGE-TREE.

Chionanthus virginica, Linnaeus.

GENUS DESCRIPTION—The genus to which the Fringe-tree belongs has only one other representative. Both species are cultivated primarily for ornamental purposes. The generic name of these trees, Chionanthus, refers to the white flowers which resemble snow.

FORM—A slender, small-sized tree usually attaining a height of 20 ft. with a diameter of 6-8 inches, but may reach a height of 40 ft. with a diameter of 12 inches. Trunk usually short, bearing numerous, stout, and ascending branches which form a rather deep, narrow crown.

BARK—On main trunk rather thin, scaly, reddish-brown; on branches light brown to orange, and smooth.

TWIGS—Rather stout, light brown tinged with green, somewhat angled, slightly hairy. Marked by large, conspicuous and elevated leaf-scars and dark colored lenticels.

BUDS—Opposite, ovoid, sharp-pointed, about ⅛ of an inch long, covered with about 5 pairs of scales which increase in length from the outer surface and ciliated on the margin.

LEAVES—Simple, opposite, thickish, ovate, 4-8 inches long, 1-4 inches wide, wedge-shaped at base, entire on margin, acute at apex, dark green above, pale and smooth below except along the veins.

LEAF-SCARS—Opposite, raised, semi-circular in outline, upper side of margin partly surrounds bud; bundle-scars solitary, large, located on cushions.

FLOWERS—Appear in May or June when leaves are just developing. Borne in drooping panicles about 4-6 inches long; perfect, white, and slightly fragrant. The appearance of the snow white flowers resembles fringe, hence the common name Fringe-tree.

FRUIT—A berry, borne in loose clusters. Dark blue in color, about ½-¾ of an inch long, and surrounded at the base by a persistent calyx. Stalks bearing the fruit may bear leaf-like bracts. Skin of fruit usually thick and stones usually thin.

WOOD—Light brown in color, with rather wide and lighter colored sapwood; heavy, hard, close-grained. Weighs about 40 lbs. per cubic foot. It is put to no special commercial uses.

DISTINGUISHING CHARACTERISTICS—The Fringe-tree, also known as Old Man's Beard, White Fringe, American Fringe, Flowering Ash, and Snow Flower tree, is native to only a few counties in the southern part of the State. This limited distribution, together with its small size and its simple, opposite, entire-margined and thick leaves will enable one to distinguish it quite readily during the summer. The white fringe-like panicles of flowers will also assist during a limited portion of early summer. In winter, the opposite, rather stout branches bearing sharp-pointed, opposite buds covered with more than 4 pairs of scales, are also characteristic. The berry-like fruit combined with the opposite branching will distinguish this tree from practically all others found in the State.

RANGE—Southern New Jersey and southeastern Pennsylvania to Florida and Texas. It is essentially a southern species.

DISTRIBUTION IN PENNSYLVANIA—This tree is found locally in about 6 counties in the southeastern part of the State. It is nowhere abundant, nor does it attain any large dimensions.

HABITAT—Usually found in rich, moist soil; also frequents banks of streams, lakes and swamps.

IMPORTANCE OF THE SPECIES—The Fringe-tree is planted extensively for ornamental purposes as far north as Massachusetts. Its beautiful flowers and its attractive form recommend it for planting in lawns and parks. The main objectionable feature is the fact that it retains its foliage for a relatively short period during the summer, since the leaves are late to appear and early to disappear. The poor quality and small size of the wood which it produces, together with its limited distribution and selective situations, do not recommend it for forestry purposes. It can readily be grafted upon our common species of Ashes. This enables one to develop it upon situations somewhat dry for the tree itself.

SWEET VIBURNUM.

Viburnum Lentago, Linnaeus.

FAMILY AND GENUS DESCRIPTION—The Honeysuckle family, Caprifoliaceae, is rather widely distributed in temperate regions. It comprises about 10 genera with 275 species of shrubs, trees, vines, and a few perennial herbs. About 8 genera are native to North America and 7 to Pennsylvania. The 7 genera native to this State comprise about 31 species, most of which are shrubs. The principal native genera are: The Elderberries (Sambucus), the Viburnums (Viburnum), the Bush Honeysuckles (Diervilla), the Honeysuckles (Lonicera) and the Snowberries (Symphoricarpos). Since most of the representatives of these genera are shrubs only a few have been discussed in this publication. A description of the others may be found in Gray's New Manual of Botany, or Porter's Flora of Pennsylvania. The Elders, belonging to the genus Sambucus, are among our best known shrubs. The Common Elderberry (Sambucus canadensis L.) is probably the best known. The flowers are conspicuous and sometimes used in making wine. The fruit is eaten and also made into wine, pies, and jellies. The Honeysuckles (Lonicera) are very common in our gardens and parks as ornamental shrubs and vines. They comprise about 100 species of which number at least 10 species are native to Pennsylvania. The Viburnums (Viburnum) also comprise about 100 species of which number about 20 species are native to North America and 11 to Pennsylvania. All of our species are usually shrubs, rarely small trees. The two species described on the following pages are occasionally found as small trees.

FORM—A shrub or small tree usually attaining a height of 10-15 ft., but may reach a height of 30 ft. with a diameter of 10 inches. Trunk usually short, bearing a round-topped crown formed by slender and usually drooping branches.

BARK—Disagreeable in odor, reddish, roughened in older specimens by division and subdivision into thick plates which are scaly on the surface.

TWIGS—At first greenish and covered with rusty hairs, later reddish to orange and rather smooth.

BUDS—Opposite, long, slender, scurfy, reddish-brown, covered by two rather rough scales. Lateral buds are usually leaf-buds and closely appressed to twigs. Terminal buds are often flower buds with a marked swelling at the base, and about ¾ of an inch long.

LEAVES—Opposite, simple, ovate, about 2½ inches long, sharp-pointed, narrowed or rounded at base, closely and very sharply serrate on margin, bright green, smooth on both upper and lower surfaces. Veins conspicuously connected by veinlets. Petioles often winged and grooved.

LEAF-SCARS—Opposite, wide, broadly U-shaped, not encircling twigs, and usually with 3 bundle-scars.

FLOWERS—Small, perfect, white, appearing in May or June in dense, many-flowered, sessile, terminal cymes which are usually 3-5 inches broad.

FRUIT—A black or dark blue fleshy, sweet, rather juicy drupe, containing a flat oval stone, and grouped into small clusters borne on slender, reddish, and often drooping stalks.

WOOD—Diffuse-porous; heavy, hard, dense, yellowish-brown, with very disagreeable and persistent odor. Weighs 45.51 lbs. per cubic foot. Not important commercially.

DISTINGUISHING CHARACTERISTICS—The Sweet Viburnum, also known as Sheepberry, Nannybery, and Wild Raisin, resembles the Black Haw more closely than any other of our native Viburnums. It can be distinguished from the latter by its leaf-blades with acuminate apexes, its long-pointed buds, and its winged petioles. The Black Haw has leaf-blades with obtuse or merely acute apexes, short-pointed buds, and no winged leaf-petioles. The small lateral branches of the Black Haw are often stiff and stand out almost at right angles to the main axis, while those of the Sweet Viburnum are flexible and more erect.

RANGE—Quebec to Manitoba, south to Georgia, Indiana and Missouri.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern, southern, and central parts of the State; local in the western part, and less frequent in the northern part.

HABITAT—Usually found along or near banks of streams and borders of lakes located in or near wooded areas.

IMPORTANCE OF THE SPECIES—The Sweet Viburnum has no commercial value, so far as wood production is concerned. Its form, flowers, fruit, and foilage make it one of the most attractive of our small ornamental trees.

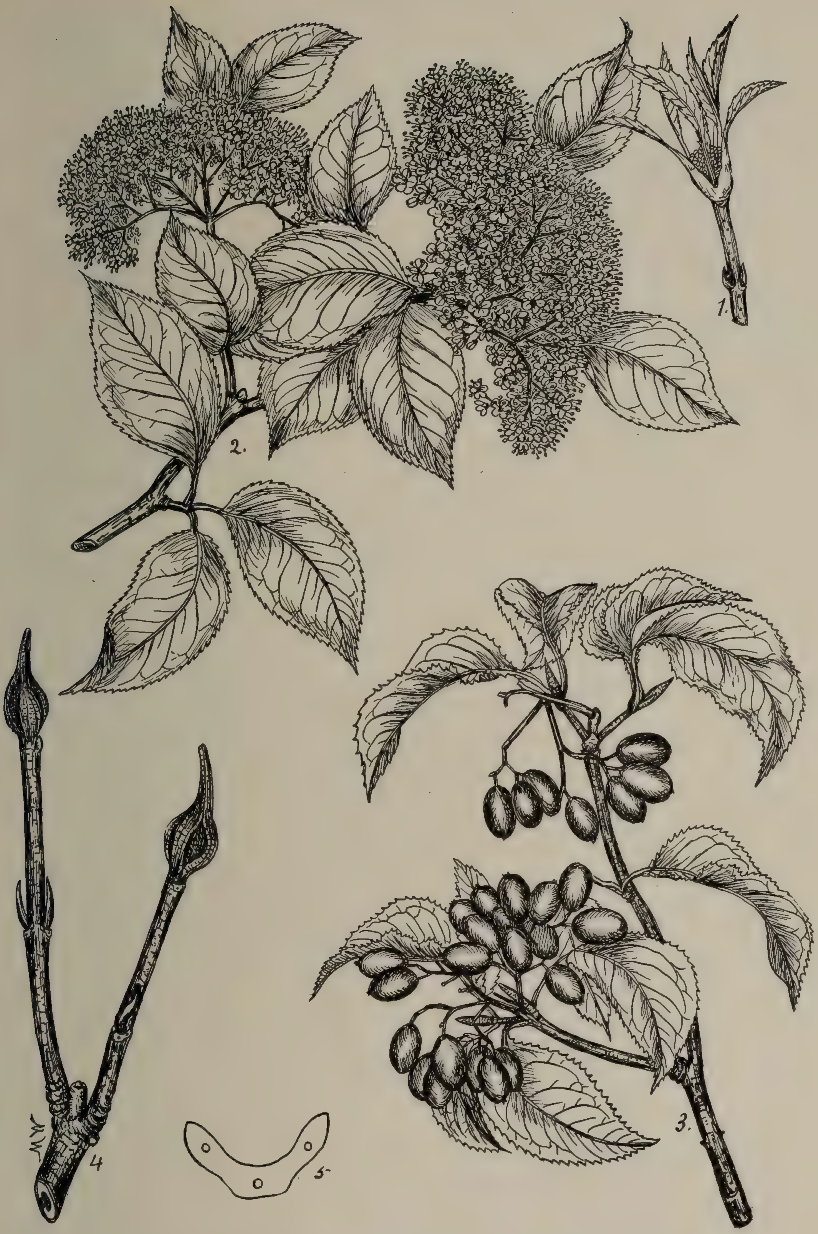

PLATE CXXVIII. SWEET VIBURNUM.

1. A twig showing the opening of a terminal bud, x ½.
2. A branchlet with leaves and two cymes of flowers, x ½.
3. A branchlet with leaves and two clusters of fruit, x ½.
4. A winter twig with lateral leaf-buds and terminal flower buds, natural size.
5. A leaf-scar with three bundle-scars, enlarged.

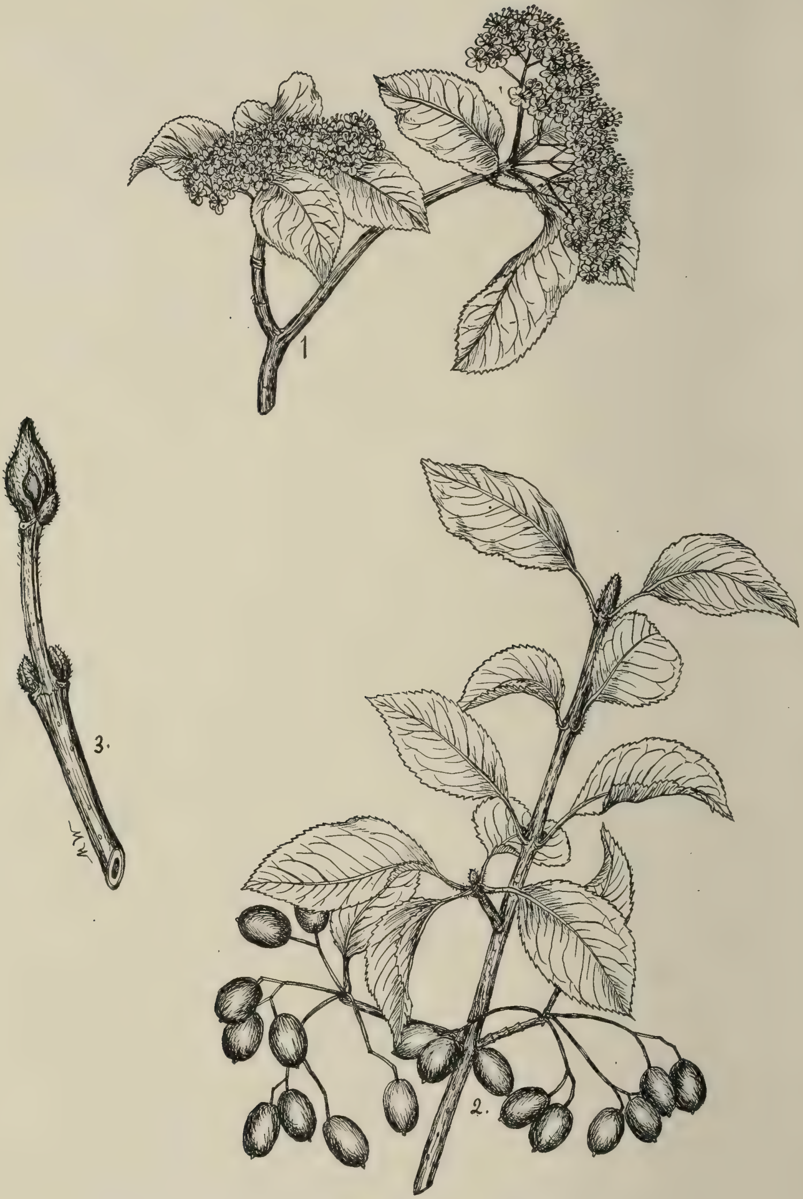

PLATE CXXIX. BLACK HAW.

1. A branchlet with leaves and two cymes of flowers, x ½.
2. A branchlet with leaves and two clusters of fruit, x ½.
3. A winter twig with a large terminal flower bud and three leaf-buds. Two leaf-buds are opposite, and located about the middle of the twig, while the third is at the base and to the right of the terminal flower bud, natural size.

BLACK HAW.

Viburnum prunifolium, Linnaeus.

FORM—A shrub or small tree usually attaining a height of 15 ft., but may reach a height of 35 ft. with a diameter of 10-12 inches. Trunk short, often crooked, bearing a rather broad and round-topped crown formed by stiff lateral branches.

BARK—About 2/5 of an inch thick, reddish-brown, rough, broken into thick plate-like scales.

TWIGS—At first reddish and smooth, then green, and later, during first winter, spine-like, gray tinged with red, and often covered with thin film-like bloom. Usually marked with orange-colored lenticels.

BUDS—Opposite, ¼-½ of an inch long, covered with 2 rusty pubescent scales which enlarge into leaf-like bodies in spring when growth begins. Axillary buds ¼ of an inch long, flattened, closely appressed to twig. Flower buds swollen near base.

LEAVES—Opposite, simple, oval, 1-3 inches long, obtuse or slightly pointed at apex, usually wedge-shaped at base, finely serrate on margin, sometimes leathery when old, dark green above and pale green below; petioles usually round, rarely winged.

LEAF-SCARS—See "Leaf-scars" under Sweet Viburnum.

FLOWERS—Small, perfect, white, appearing about May in dense, many-flowered, sessile, and terminal cymes which are 3-4 inches broad.

FRUIT—Fleshy, dark blue drupe which is persistent, sweet and rather juicy; contains a flat oval stone; grouped in few-fruited clusters borne on reddish stalks.

WOOD—See "Wood" under Sweet Viburnum.

DISTINGUISHING CHARACTERISTICS—The Black Haw, also known as Sweet Haw, Sheepberry, Stag-bush, and Nanny-berry, closely resembles the Sweet Viburnum. See "Distinguishing Characteristics" under Sweet Viburnum. The Black Haw and the Sweet Viburnum may further be distinguished from the Maple-leaved Viburnum (Viburnum acerifolium) by the palmate venation of the leaf-blade and the small gaping buds of the latter, and from the Arrowwood (Viburnum dentatum) by the coarsely dentate leaves, the small gaping buds, and the evidently-stalked flower clusters of the latter.

RANGE—Connecticut, south to Georgia, and west to Arkansas.

DISTRIBUTION IN PENNSYLVANIA—Common in the eastern and southern parts of the State, and local to sparse in the other parts.

HABITAT—Prefers dry rocky hillsides. Sometimes found in rather moist locations. Frequent along fences and roadsides where seeds may have been dropped by birds. Often forms almost impenetrable thickets along fences, especially when coppiced.

IMPORTANCE OF THE SPECIES—It is of no commercial importance as a wood-producing tree, but for ornamental purposes deserves to be planted extensively. The bark of the roots is valuable medicinally.

GLOSSARY.

Abortion. Imperfect development or non-development of an organ.

Abortive. That which is brought forth prematurely; coming to naught before it is completed.

Achene. A small, hard, dry, 1-celled, 1-seeded fruit which does not open by valves.

Acrid. Sharp or biting to the taste.

Acuminate. Decidedly tapering at the end.

Acute. Tapering at the end.

Aesthetic. Pertaining to the beautiful.

Afforesting. Turning ground into forest after being without a forest for a considerable length of time.

Alluvial. Relating to the deposits of sand, clay, or gravel made by river action.

Alternate. Not opposite to each other, but scattered singly along the axis.

Ament. A peculiar, scaly, unisexual spike.

Anther. The enlarged terminal part of a stamen which bears the pollen.

Apex. The tip or end of a bud or leaf, i. e. the part opposite the base.

Apical. Pertaining to the tip, end, or apex.

Appressed. Lying tight or close against.

Arborescent. Tree-like in appearance, size, and growth.

Aromatic. Fragrant; with a pleasing odor.

Astringent. Contracting; drawing together; binding.

Axil. The upper angle formed by a leaf or branch with the stem.

Axillary. Situate in an axil.

Axis. The central line of an organ; a stem.

Bark. The outer covering of a trunk or branch.

Basal. Pertaining to or situated at base.

Berry. A fruit which is fleshy or pulpy throughout.

Bisexual. Having both stamens and pistils, i. e. male and female organs.

Bloom. A powdery or somewhat waxy substance easily rubbed off.

Bole. The body or stem of a tree.

Boreal. Pertaining to the north.

Bract. A modified leaf subtending a flower or belonging to an inflorescence.

Bud-scales. Modified leaves covering a bud.

Bundle-scars. Scars on the surface of a leaf-scar. Severed ends of the fibro-vascular bundles which connected the twigs with the leaves.

Calyx. The outer portion of a flower, usually green in color.

Cambial. Pertaining to the cambium.

Cambium. A thin-walled formative tissue between the bark and wood.

Capsule. A dry fruit composed of more than one carpel and splitting open at maturity.

Carpel. A simple pistil or one member of a compound pistil.

Catkin. An ament or spike of unisexual flowers.

Chambered. Said of the pith when interrupted by hollow spaces at rather regular intervals.

Ciliate. Fringed with hairs on the margin.

Coherent. Sticking together; connected.

Collateral. Accessory buds at the sides of axillary buds.

Complete. Said of flowers when all parts are present.

Compound. Composed of two or more similar parts united in a whole.

Concentric. Said of growth rings when the growth center coincides with the geometrical center.

Confluent. Flowing together; uniting. Said of the bundle-scars when the separate ones flow together and appear as one.

Conical. Cone-shaped.

Conifers. A group of trees which usually produce their fruit in the form of a cone.

Coniferous. Cone-bearing.

Conniving. Brought close together.

Contorted. Twisted together or back upon itself.

Convergent. Tending to one point.

Cordate. Heart-shaped.

Corolla. The inner portion of perianth, composed of petals. The bright colored part of most flowers.

Corymb. A flat-topped or convex flower cluster, blooming first at the edges.

Corrugated. Shaped into grooves, folds, or wrinkles.

Crown. The upper mass of branches, also known as head.

Cyme. A flower cluster blooming from apex or middle first, usually somewhat flat.

Cymose. In a cyme; cyme-like.

Deciduous. Falling off, usually at the close of the season.

Decurrent. Extending down the stem below the insertion.

Defoliation. Removal of foliage.

Dehiscent. Splitting open.

Deliquescent. Said of the form of a tree with a broad spreading habit. The branches subdivide until they apparently disappear.

Deltoid. Delta-like, triangular.

Dentate. Toothed, usually with the teeth directed outwards.

Diffuse-porous. Equal-pored. Said of wood when pores in a growth ring are equal in size.

Digitately-compound. With the members arising at the same point at the end or top of the support.
Dioecious. Unisexual, with the two kinds of flowers on different plants.
Disseminated. Scattered; thrown broadcast.
Divergent. Pointing away; extending out. Said of buds which point away from the twigs.
Downy. Covered with fine hairs.
Drupe. A fleshy fruit with a pit or stone.
Eccentric. Not circular. Said of growth rings when growth center does not coincide with geometrical center.
Elongated. Long drawn out.
Embryo. A young plant in a seed.
Entire-margined. Margin smooth, not cut or roughened.
Epidermis. The outer layer or covering of plants.
Equidistant. Equal distances apart.
Even-pinnate. With all the leaflets occurring in pairs.
Excurrent. Said of a tree with a continuous trunk and erect habit of growth.
Exfoliation. Splitting or cleaving off of outer layers of bark.
Exotic. Of foreign origin.
Exudation. Oozing out of sap, resin, or milk.
Fascicle. A cluster, usually dense.
Fertilization. The process by which pollen stimulates the ovule to produce a seed.
Fetid. Ill-smelling.
Fibro-vascular bundles. The conducting strands which connect the leaves with the stem.
Fibrous. Consisting of fibers; woven in texture.
Filament. The stalk bearing the anther.
Fissures. Grooves, furrows, or channels as in the bark.
Flora. The complete system of plants found in a given area.
Fluted. Grooved, corrugated, channeled.
Follicles. A dry fruit of one carpel, splitting on one side only.
Forestry. The rational treatment of woodlands for their products.
Fruit. A developing or ripened ovary. It may also include the axis containing the real fruit.
Fungus. A plant devoid of green color such as mushrooms and rots.
Gaping. **With an open slit at the end or apex.**
Genus. A group of related species, as the pines or the oaks.
Glabrous. Smooth, without hairs.
Glandular. Bearing glands or gland-like.
Glaucous. Covered with a bluish or whitish waxy coating; a bloom.
Globose. Ball-like or nearly so.
Globular. Ball-like.
Habitat. The home of a plant.
Head. A dense cluster of sessile flowers or the crown of a tree.
Heartwood. The dead, central, usually highly colored portion of the trunk.
Herbaceous. Herb-like, soft.
Heterogeneous. Composed of dissimilar elements, as the wood of the hardwoods.
Homogeneous. Composed of closely resembling elements, as the wood of the conifers.
Imbricated. Overlapping like the slate on a roof.
Incomplete. Said of flowers in which one of the outer parts is wanting.
Increment. Growth; increase.
Indehiscent. Applied to fruits that do not split open to let out the seeds.
Indigenous. Applied to plants that are native to a certain locality.
Inflorescence. The flowering part of a plant, and especially its arrangement.
Intolerant. Not shade enduring. Requiring sunlight.
Involucre. A circle of bracts surrounding a flower or cluster of flowers.
Irregular. Said of flowers showing inequality in the size, form, or union of similar parts.
Keeled. With a central ridge, like the keel of a boat.
Lamina. The blade or flattened portion of a leaf.
Lanceolate. Shaped like a lance; several times longer than wide.
Lateral. Situated on the side, as the buds along the side of the twig.
Leaflets. One of the small blades or divisions of a compound leaf.
Leaf-scars. The scar left by the falling of a leaf.
Lenticels. A corky growth on young or sometimes older bark which admits air to the interior of the twig or branch.
Linear. Line-like, long and narrow, with parallel edges.
Lobed. Said of leaves that have the margins more or less cut or divided.
Lunate. Of the shape of a half-moon or crescent.
Manna. A sweetish secretion used in medicine as a mild laxative.
Medullary. Pertaining to the pith or medulla.
Medullary Ray. Radial lines of tissues crossing the growth rings at right angles and extending into the bark.
Midrib. The central or main rib or vein of a leaf.
Mongrel. Composed of two elements of entirely different origin.
Monoecious. Bearing stamens and pistils in separate flowers on the same plant.
Morphological. Pertaining to the form and structure of plants.
Mucilaginous. Shiny, or gummy when chewed.
Naked. Said of buds without scales and seeds without a covering.
Naval Stores. Refers to tar, turpentine, resin, etc.

Nerve. One of the lines or veins running through a leaf.

Node. A place on a twig where one or more leaves originate.

Non-porous. Without pores.

Nut. A dry, 1-seeded, indehiscent fruit with a hard covering.

Nutlet. A small nut.

Ob-. A prefix meaning inverted or reversed.

Oblique. Slanting, uneven.

Oblong. About twice as long as wide, the sides nearly parallel.

Obovate. Reversed egg-shaped.

Obtuse. Blunt.

Odd-pinnate. With an odd or unpaired leaflet at the tip of the compound leaf.

Opposite. Said of leaves and buds, directly across from each other.

Orbicular. Circular.

Ovary. The part of the pistil producing the seed.

Ovate. Egg-shaped.

Ovoid. Egg-shaped or nearly so.

Ovule. The body which after fertilization becomes the seed.

Palmate. Hand-shaped; radiately divided.

Panicle. A compound flower cluster, the lower branches of which are longest and bloom first.

Parasite. Growing upon and obtaining its nourishment from some other plant.

Parenchyma. A class of plant tissue found in the green layers of the bark, in wood and pith.

Pedicel. The stalk of a single flower.

Peduncle. The stalk of a flower cluster or of a solitary flower.

Pendulous. Hanging.

Perennial. Last for more than one year.

Perfect. A flower with both stamens and pistils.

Perianth. A term applied to the calyx and corolla taken together.

Persistent. Remaining after blooming, fruiting, or maturing.

Petals. The part of a corolla, usually colored.

Petiole. The stalk of a leaf..

Pinna. A division, part, or leaflet of a pinnate leaf.

Pinnate. With leaflets on both sides of a stalk.

Pistil. The central part of the flower containing the prospective seed.

Pistillate. Bearing pistils but no stamens.

Pith. The soft central part of a twig.

Pod. Any dry and dehiscent fruit.

Pollen. The dust-like substance found in the anthers of a flower.

Pollination. The process of bringing the pollen of the male flower in contact with the stigma of the female flower.

Polygamous. With both perfect and imperfect, staminate or pistillate, flowers.

Pome. A fleshy fruit with a core, such as the apple.

Prickle. A sharp-pointed, needle-like outgrowth.

Profligate. Wasteful, extravagant.

Propagative. Said of buds containing reproductive organs.

Pseudo-. A prefix meaning false, not true.

Pubescent. Hairy.

Pungent. Ending in a sharp point; acrid.

Pyramidal. Shaped like a pyramid with the broadest part near the base.

Raceme. A simple inflorescence of flowers borne on pedicels of equal length and arranged on a common, elongated axis.

Ray. See *Medullary ray.*

Reflexed. Abruptly turned backward or downward.

Reforestation. The process of putting a forest growth upon an area which had its forest growth removed recently.

Regular. Said of flowers which are uniform in shape or structure.

Resin-ducts. A passage for the conduction of resin found in the leaves and wood of the Pines.

Ring-porous. Said of wood which has pores of unequal size, the larger ones being found in the spring wood and the smaller in the summer wood.

Rugose. Wrinkled.

Rugosities. Projections, wrinkles, knobs.

Saccharine. Pertaining to or having the qualities of sugar.

Samara. An indehiscent winged fruit.

Sapwood. The recently formed, usually light wood, lying outside of the heartwood.

Scales. The small, modified leaves which protects the growing-point of a bud or the part of a cone which bears the seeds. The small flakes into which the outer bark of a tree divides.

Scurfy. Covered with small bran-like scales.

Sepal. One of the parts of the calyx.

Serrate. Having sharp teeth pointing forward.

Sessile. Seated; without a stalk.

Sheath. A tubular envelope or covering.

Shrub. A low woody growth which usually branches near the base.

Silky. Covered with soft, straight, fine hairs.

Simple. Consisting of one part, not compound.

Sinus. The cleft or opening between two lobes.

Species. A group of like individuals as Red Oak, White Oak, etc.

Spike. An enlongated axis bearing sessile flowers.

Spile. A small peg or wooden pin. Sometimes synonymous with pile.

Spine. A sharp woody outgrowth.

Stamen. The part of a flower which bears the pollen.

Staminate. Said of flowers which bear only stamens. Sometimes spoken of as male.

Sterigmata. The projections from twigs bearing leaves.

Sterile. Barren; unproductive.

Stigma. The end of a pistil through which pollination takes place.

Stipule. A leaf-appendage at the base of the leaf-stalk.

Stipule-scar. The scar left by the fall of the stipule.

Stoma. An opening in the epidermis of a leaf communicating with the internal air cavities.

Striate. Marked with fine elongated ridges or lines.

Striations. Long narrow lines or ridges.

Strobile. A fruit marked by overlapping scales as in the Pine, Birches, etc.

Style. The pin-like portion of the pistil bearing the stigma.

Sub-. A prefix meaning under or nearly.

Sucker. A shoot arising from an underground bud.

Superposed. Said of buds when they are arranged one above the other.

Symmetrical. Regular as to the number of parts. Having the same number of parts in each circle.

Terminal. Pertaining to buds located at the end of twigs.

Thorn. A stiff, woody, sharp-pointed projection.

Tolerant. Applied to trees which endure certain factors, particularly shade.

Tomentum. A dense layer of hairs.

Tomentose. Densely pubescent; hairy.

Truncate. Ending abruptly, as if cut off at the end.

Tubercle. A small tuber or tuber-like body.

Tufted. Growing in clusters.

Umbel. A flower-cluster with all the pedicels arising from the same point.

Unisexual. Consisting of one sex only, either staminate or pistillate.

Valvate. Said of buds in which the scales merely meet without overlapping.

Vegetative. Said of buds which do not contain reproductive organs.

Veins. Threads of fibro-vascular tissue in leaves or other organs.

Versatile. Used for many purposes.

Viscid. Glutinous; sticky.

Whorl. A group of three or more similar organs, as leaves or buds, arranged about the same place of attachment.

Whorled. Borne in a whorl.

Xylology. The science which treats of the form and structure of wood.

* * *

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Insects as Carriers of the Chestnut Blight Fungus

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INSECTS AS CARRIERS OF THE CHESTNUT BLIGHT FUNGUS[1]

HISTORICAL INTRODUCTION.

The relation which various insects bear to the dissemination of plant diseases is a subject which has received the attention of a large number of plant pathologists within recent years. In the majority of cases, however, in which insects have been held responsible for the spread of plant diseases, the evidence given in support of the accusation was quite meager and only circumstantial. In presenting a review of the literature bearing on this subject, no claim is made for completeness; it is our intention merely to point out some of the noteworthy instances in which insects have been considered responsible for the dissemination of fungi or bacteria which are saprophytic or paratitic upon plants.

Taking up first the bacterial side of the question, we find that as early as 1892 Waite (53, 54) reported definite experiments to show that the fire blight of the pear and the apple can be carried by insects. Bees, wasps, and flies were shown to carry the causal bacteria from blossom to blossom, and Waite showed that this mode of dissemination was the cause of the rapid spread of the disease in the spring. Furthermore, this author believed that the twig blight, caused by the same organism, frequently had its origin from bacteria carried by insects, although no experimental data are cited on this point. That this supposition is correct has since been proved by a number of workers. Extensive observations made by Jones (28) strongly indicated that new infections of the twigs of apples after the blossoming season were due largely to transmission by aphids, and this same author has also shown (28, 29) that the bark boring beetle, *Scolytus rugulosus,* causes large numbers of twig infections both on apple and pear trees. The spread of the blight in nursery stock has been shown by Stewart (49, 50) frequently to be due to the tarnished plant bug, *Lygus pratensis;* and while he proved many infections to be caused by aphid punctures, he does not believe that aphids play such an important part in the dissemination of the blight as was thought by Jones.

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[1] Investigations conducted jointly by the Office of Forest Pathology, Bureau of Plant Industry, and the Pennsylvania Chestnut Tree Blight Commission.

It was early conjectured by Smith (45) and by Russell (41) that the black rot of cabbage due to *Pseudomonas campestris* may be transmitted by various insects. Evidence in support of this supposition has been brought forward by several writers; Brenner (5) showed that aphids may cause new infections, and Smith (46, pp. 306-307) succeeded in transmitting the disease by means of the larvae of a cabbage butterfly, *Plusia.*

Insects have been accused of spreading several other bacterial diseases of plants. Smith (43) cited experiments indicating that the wilt of Cucurbits due to *Bacillus tracheiphilus* may be spread by several insects. The same writer (44) also showed that the Colorado potato beetle *Leptinotarsa (Doryphora) decemlineata,* could produce new infections of *Bacillus solanacearum,* the cause of a disease of the tomato, eggplant, and Irish potato, and was led to the conclusion that insect enemies are largely responsible for the spread of the disease. Johnston (27) presents some evidence to show that the coconut bud rot may be carried by insects, and Horne, Parker, and Daines (25) suggest that the dissemination of the olive knot disease may be due to insects.

Some interesting experiments conducted by Berlese (4) show that not only are yeast cells still viable after passing through the intestine of flies, but that they even multiply and enormously increase in numbers while in the alimentary tract. His experiments lead him to the conclusion that ants and flies play a great part in the distribution, preservation, and multiplication of yeasts.

A much greater number of instances can be cited of the dissemination by insects of the spores of fungi than of bacterial diseases of plants. One of the oldest and best known examples is that of the ergot of rye. It has long been known (de Bary, 3, p. 228) that a saccharine secretion oozes out from the conidia-bearing surface. This secretion, in which the conidia are imbedded, is eagerly sought by insects, which necessarily carry away large numbers of the conidia. A large number of species of insects has been found by Stäger (47, 48) to visit ergot-infected grasses. Mercier (35) showed that the spores were not only carried mechanically on the surfaces of the bodies of insects but that they were also found in their excrement. This latter statement, however, has been questioned by Gain (13).

Insects have been shown by various writers to carry rust spores. Magnus (33) called attention to the fact that the teleutospores of various species of Diorchidium, and especially *D. steudneri,* are well adapted to insect transport on account of the fact that they are set free in dew drops, or other moisture, and are sticky. Klebahn (31) thinks that insects play a part in the local dissemination of rusts in general. This author also thinks that the bright color of some rusts may attract insects. Falck (10) suggests the probability that rust pycnospores are also distributed by insects, in the same manner as the teleutospores. Johnson (26) has made a microscopic examination of a large number of thrips found on wheat florets. A large per cent. of the thrips was found to be carrying spores; in one instance "five rust spores and three conidial spores of imperfect fungi were observed attached to the antennae and appendages of a single thrip." This writer is of the opinion that the presence of rust spores between the glumes of florets of wheat and the consequent rusting of the heads which he observed, were due in part to the activities of the thrips.

Ludwig (32, p. 369) has pointed out the close similarity between the spores of smut fungi and pollen grains. He calls attention to the fact that those smut spores which have a roughened cell wall are found on those parts of their hosts which are regularly visited by insects. Such spores very frequently develop in the anthers of insect pollinated flowers. On the other hand, the smooth walled spores are more frequently met with on those parts of plants where insects are less commonly found, or on wind pollinated plants. An analogy with the pollen grain suggested to Ludwig that the rough walled spores are disseminated by the agency of insects, and those which are smooth walled by the wind.

That the bitter rot of apples can be carried by insects was first shown by Clinton (7), who succeeded in inoculating sound apples by keeping them in a moist chamber with some bitter rot apples and some flies of the genus Drosophila. Clinton was of the belief that these flies carried the ascospores from mummied apples to green apples and were thus responsible for a large number of new infections in the spring. Burrill (6) repeated Clinton's experiments with the same positive results, and also gives more data to prove that these flies are capable of spreading the disease. He reaches the conclusion, however, that insects play only a small part in the dissemination of bitter rot in the orchard.

Another very well known example of spore distribution by insects is found in the carrion fungi. This is especially true of the common stink horn, *Phallus impudicus,* which is reported as the cause of a root disease of the grape in Hungary (Istvánffy 23, 24). Von Schlechtendal (42) was the first to recognize that the spores of this species are carried by flies, which are attracted by the foetid odor of the slimy mass in which the spores are imbedded. Of the later work on this form we may mention that of Ráthay and Haas (40) and of Fulton (12). The former pointed out the special adaptation of the sporophores for insect visitation, and that other insects besides flies visit the mature spore-bearing surfaces. Fulton found by microscopic examination, that thousands of spores cling to the feet and proboscides of the flies, and that the spores are still viable after passing through the digestive tract of flies. Cobb (8) working with a species of Ithyphallus, closely allied to *Phallus impudicus* and paratitic on sugar cane, has shown that the spores of this fungus also are widely disseminated by flies and other insects. The number of spores per foot print of a fly may be as high as 860,000, and it was shown that these were capable of germinating. Five fly specks contained on an average of 22,400,000 spores, many of which were viable.

Heald (15) has established an intimate relation between the bud rot of carnations and certain mites. These develop in the mass of rotted petals, and the young migrate to healthy buds, carrying the spores of the causal fungus with them.

Massee (34, p. 184) has pointed out that the rapid spread of apple canker in England due to *Nectria ditissima,* coincided with the introduction of the American blight, or woolly aphis. He is of the opinion that the canker would not have been present in an epidemic form had the insect not been introduced into England.

Grossenbacher and Dugger (14) have pointed out that the blight of currants due to *Botryosphaeria ribis* may be carried by several insects, the most likely of which is the American currant borer, *Psenocerus supernotatus.* This insect was not found in blight-free plantations. The authors conclude that "since the imago eats the fungus and the larva lives as a borer in the host, the beetle's habit of oviposition may have some relation to the dissemination of the fungus and the inoculation of the host."

The statement is made by Jones, Giddings, and Lutman (30) that leaf eating insects function in the distribution of the spores of the potato fungus, *Phytophthora infestans.* A related fungus, *P. phaseoli,* a mildew on the lima bean, is believed by Sturgis (52) to be spread by bees. This is based on observations in the field and on a study of the structure of the flower and pod of the lima bean.

The sooty mold of the orange and other citrous fruits, due to *Meliola camelliae,* follows the attacks of certain scales and aphid-like insects. In Florida (Webber, 55) the trouble becomes serious when it follows infestations of the white fly, *Aleyrodes citri,* and the fungus derives its nourishment from the honey dew secreted by this insect. The amount of sooty mold depends directly on the amount of honey dew present, or upon the distribution of the white fly, which, furthermore, acts as an agent in transmitting the spores of the fungus.

The mosaic disease of tobacco has generally been considered a physiological trouble. Allard (1) expresses the opinion, however, that paratitism offers the more plausible explanation of the ultimate cause of the disease. The observations of this author indicate that aphids may sometimes be responsible for the occurrence of the trouble in the seed bed and its subsequent spread in the field. He has succeeded in keeping the disease under complete control in the greenhouse by frequent fumigations to exclude aphids.

In some of the instances cited the conclusion that insects play a part in the dissemination of these organisms was based merely upon circumstantial evidence. However, in a sufficient number of them enough substantial experimental evidence was presented to point to the importance of insects as carriers of fungous spores and of bacteria parasitic upon plants.

We may next consider the literature bearing upon the relation of insects to the spread of the chestnut blight, or bark disease, caused by the fungus, *Endothia parasitica* (Murr.) A. and A. From the very beginning of the study of this disease insects have received a good share of the blame for its spread. In 1906 Murrill (38) stated that from the numerous yellowish-brown pustules produced by the blight, "millions of minute summer spores emerge from day to day in elongated reddish-brown masses, to be disseminated by the wind and other agencies, such as insects, birds, squirrels, etc." Later in the same publication he added that "every bird and insect that rests upon an infected spot is liable to carry the spores upon its feet or body to other trees."

Several years later Hodson (22) said that "the spores are no doubt carried by animals, birds, insects, and by the shipment of infected material," The statement is made by Metcalf and Collins (37) that "there is strong evidence that the spores are spread extensively by birds, especially woodpeckers, and there is also excellent evidence that they are spread by insects and by various rodents, such as squirrels." An essentially similar statement was made the following year by Metcalf (36).

In discussing the methods by which conidia are transported from one tree to another, Rankin (39) makes the following statement: "Reasoning by analogy with what is known of the behavior of many fungi, such agencies as borers, birds, ants and the wind, etc., have been suggested but in no wise proved to be responsible."

Fulton (11) reports that a detailed study of a spot infection at Orbisonia, Pa., by Mr. R. C. Walton showed beetle larvae in or near fully nine-tenths of the old lesions, and about two-fifths of the youngest lesions. He concludes, therefore, that the larvae usually follow rather than precede the infection. Various other writers have noted this evident relation between chestnut blight cankers and the holes and tunnels of wood borers, and this is no doubt one of the reasons that insects have been so frequently suggested as carriers of spores. Anderson and Babcock (2) call attention to the fact that probably all of the larvae living in chestnut trees emerge either as adults, leaving the pupal case behind them, or else go into the ground to pupate immediately after emerging; in either case they would have very little opportunity of carrying spores from one tree to another.

Ants have also frequently been found in old blight lesions (11, 39), and have therefore been rather extensively accused of spreading the blight spores and causing infections. Anderson and Babcock (2) have carried out a number of experiments with ants taken from blight cankers. In one of these the ants were permitted to run over potato agar plates, but no colonies of *Endothia parasitica* developed. The experiment was repeated by Mr. R. D. Spencer, under Mr. Anderson's supervision, with the same negative results. We agree with Mr. Spencer (2) that the method is very likely at fault, for the comparatively slow-growing colonies of the blight fungus would soon be crowded out and overrun by other more rapid-growing fungi or bacteria. A more satisfactory method was employed in the next experiment reported by Anderson and Babcock, in which five vials of ants were placed into melted agar, which was just warm enough so that is would not solidify. The tubes were well shaken and the agar poured into Petri dishes. "Ants from three of the vials proved to have spores on them. The spores had been artificially placed on the ants in one of the vials, however. The ants in the other two had been taken from the bark of the diseased chestnut trees after a rain. This indicates that the ants can carry the spores." It would be interesting to know the actual number of spores carried in these instances.

In another experiment ants, which had been previously placed in water milky with conidia, were allowed to run in a bottle of earth. Two of these were taken out at intervals and tested in the same manner as was described in the experiment just preceding. Positive results were obtained for five hours and sixteen minutes after placing the ants into the bottle, at which time the last test was made. The authors are led to the conclusion that "this shows that ants may retain the spores long enough to carry them some distance." Here again it would be interesting to have the quantitative results and to know whether the number of spores diminished gradually from the first to the last test.

There are a number of insects known to eat the pustules of the chestnut blight fungus (9), but the most common of these in Pennsylvania is the beetle, *Leptostylus macula* Say. In order to determine whether this habit of eating the spores is beneficial, the following tests have been reported (2 and 9): A number of the beetles were fed on pustles for five days, after which their viscera were removed with sterile needles, put into melted potato agar and plated out. Bacteria developed in the plates but no fungous colonies were obtained. Other beetles of this species were fed on ascosporic stromata for a day and "caused to excrete the fecal material by a light pressure on the abdomen with the forceps. The fecal material was caught in potato agar tubes and plated out with the same negative results as in the preceding experiment. These experiments indicate that the insect may really be beneficial," (2) since the spores are not passed out in the excreta to germinate on other hosts. The present writers agree that this beetle is beneficial in so far as it destroys the spores and pustules, but the point seems to have been overlooked that a beetle of this habit has excellent opportunities for collecting and carrying away a large number of spores on its feet and body, and that new infections may be caused as a result of the rattling off of these spores.

The writers above referred to (2) came to the general conclusion that "insects are not important agents in the spread of the blight, except in so far as they produce wounds by which the spores may enter."

There has been much conjecture as to the part played by the bast miner, *Ectoedemia phleophaga*, an insect which is very abundant on the chestnut. The adult of this insect is an extremely small Micro-Lepidopterous form which, judging from its life history, cannot in our opinion cause new infections directly. It is of great importance, however, from the fact that the large number of openings which this form makes in the bark of the chestnut serve as points in which new infections may start from spores introduced by other means than by the ast miner.

METHOD.

The authors wish to express their appreciation for the many helpful suggestions and criticism of Dr. F. D. Heald, under whose supervision the work was carried out. Credit is also due to Prof. W. M. Wheeler of Harvard University for the determination of all the ants herein reported.

The insects used in these tests were for the most part collected in the field, but some of them were ants used in certain laboratory and insectary tests. Those brought in from the field were collected at four different points in Pennsylvania,—West Chester, Valley Forge, Lehighton, and Fairmount Park, Philadelphia. All but three of these insects (Nos. 69-71) were picked directly from chestnut blight cankers with sterile forceps, and dropped into sterile tubes plugged with cotton. In some instances use was made of cyanide tubes, also plugged with cotton and sterilized in the autoclave. It had been previously determined that the potassium cyanide has no appreciable effect on spores of the blight fungus (16).

When brought to the laboratory each insect was dropped into a flask containing 100 cc. of sterile tap water. The flask was shaken at intervals and the insects were always permitted to remain in the water for at least several hours before the plate cultures were made, or, in many instances in which they were brought to the laboratory in the late afternoon or evening, they were kept in the flasks all night, thus affording sufficient opportunity for the spores to become loosened from their feet and body. By means of a sterile pipette small quantities of this wash water were transferred to Petri dishes and a tube of melted 3% dextrose agar (+10), which had been previously cooled to 42-45°C., added to each plate. The quantities of wash water found the most satisfactory and used in nearly all cases were 1 cc., 10 drops and 5 drops to each Petri dish, although in a few instances it was thought advisable to add to these a greater dilution, and 1 cc. from a second flask (containing 1 cc. of wash water in 100 cc.) was used. A record was kept of the number of drops delivered by each pipette, and this was found to be fairly constant for any single pipette, although it varied considerably for the different ones used.

The plates were incubated in the laboratory, the temperature of which was kept approximately at 25° C. Colonies suspected of being the blight fungus were marked on the fourth day with India ink, and the counts were verified two or three days later, at which time any doubtful colonies were transferred to agar slants to make certain of their identity. A count was also made of the number of bacterial or yeast colonies, the number of fungous colonies not *Endothia parasitica,* and the number of species of fungi represented other than the blight fungus, as nearly as could be determined from cultural characteristics. Knowing the calibration of the pipette used, it was an easy matter to compute from the above information the number of viable spores of the blight fungus, the number of spores of other fungi and the number of bacteria and yeasts carried by each insect.

Those insects which had been used in the laboratory and insectary tests were collected and cultures made from them in essentially the same way as those brought in from the field, except that no record was kept of the number of fungous species represented in the cultures.

After the plates had been poured, the insects were preserved for classification, and beginning with insect No. 34, a few cc. of formalin were added to the wash water to inhibit the growth of spores. At a later time the wash water from those insects yielding positive results was centrifuged in 10 cc. quantities and the sediments thus obtained thrown together and centrifuged again. All but a small quantity of water at the bottom of the centrifuge tube was then carefully drawn off with a pipette, thus concentrating the entire sediment in 1 cc. or less of water. This sediment was given a thorough microscopic examination, primarily to determine whether the spores of the blight fungus present were pycnospores or ascospores, but also to get an idea of the other kinds of spores which the insects were carrying.

RESULTS OBTAINED FROM THE CULTURES.

As has already been stated, insects Nos. 1-18 and 23-25 were taken from certain experiments carried on in the laboratory and insectary at Philadelphia. All of these were red ants belonging to the same species (Table I). Before being tested Nos. 1-3 and 10-18 were permitted to run over pieces of moistened chestnut bark bearing active perithecia, while Nos. 4-9 had run over bark bearing spore horns.

Of these 21 ants, 5 yielded positive results, two of them carrying 2,733 and 4,000 spores of *Endothia parasitica* respectively (Table I). Only one of these five had had access to pycnidial material, while the other four had been on and about bark bearing active perithecia.

TABLE I.—RESULTS OBTAINED FROM CULTURES.

Number.	Name of Insect.	Date of collection, 1913.	Locality at which collected (Penna.)	No. of bacterial and yeast colonies.	No. of *Endothia parasitica* colonies.	No. of other fungous colonies.	No. of fungous species not *Endothia parasitica*.
1	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	Feb. 7	Laboratory,	Present	866	?	....
2	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	Feb. 7	Laboratory,	Present	2733	?	....
3	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	Feb. 7	Laboratory,	?	4000	?	....
4	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nly.,	Mar. 11	Insectary,	300	0	1300	....
5	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	Mar. 11	Insectary,	400	0	400	....
6	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	Mar. 11	Insectary,	300	0	3000	....
7	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	Mar. 14	Insectary,	2450	0	500	....
8	Ant, *Formica rufa*, Linn. Subsp. *integra*, *Nyl.*,	Mar. 14	Insectary,	18400	0	200	....
9	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	Mar. 14	Insectary,	11	0	9000	....
10	Ant, *Formica rufa*, Linn. Subsp. *integra* Nyl.,	April 4	Insectary,	1350	0	1252	....
11	Ant, *Formica rufa*, Linn, Subsp. *integra*, Nyl.,	April 4	Insectary,	686	838	1904	....
12	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	April 4	Insectary,	10080	0	400	....
13	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	April 8	Insectary,	218	0	218	....
14	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	April 8	Insectary,	291	0	146	....
15	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	April 8	Insectary,	73	0	363	....
16	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	April 18	Insectary,	296	0	148	....
17	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	April 18	Insectary,	825	0	375	....
18	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	April 18	Insectary,	9153	0	3763	....
19	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	May 19	West Chester,	147	0	1988	....
20	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	May 19	West Chester,	0	0	158	....
21	Ant, *Formica rufa* Linn. Subsp. *integra*, Nyl.,	May 19	West Chester,	0	0	0	....
22	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	May 19	West Chester,	68577	74	0	....
23	Ant, *Formica rufa*, Linn. Subsp. *interga*, Nyl.,	May 21	Insectary,	0	0	605	....
24	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	May 21	Insectary,	280	1400	700	....
25	Ant, *Formica rufa*, Linn. Subsp. *integra*, Nyl.,	May 21	Insectary,	1680	0	560	....
26	Fly, Trypetid,	May 19	West Chester,	0	0	?	....
27	Fly, Trypetid,	May 19	West Chester,	0	1051	132	....
28	Fly, Trypetid,	May 19	West Chester,	0	0	671	....
29	Ant. *Leptothorax curvispinosus* Mayi,	June 3	Valley Forge,	840	0	840	1
30	Beetle, *Leptostylus macula* Say,	June 3	Valley Forge,	0	336960	960	2
31	Ant, *Leptothorax curvispinosus* Mayi,	June 3	Valley Forge,	880	0	0	0

32	Ant, *Formica fusca* L. var. *subsericea* Say,	June 3	Valley Forge,	0	0	0	0
33	Nymph of a Heteropteron,	June 3	Valley Forge,	0	0	840	1
34	Nymph of a tree hopper,	June 5	Lehighton,	0	0	587	2
35	Nymph of a tree hopper,	June 5	Lehighton,	229	0	305	4
36	Nymph of a tree hopper,	June 5	Lehighton,	100	249	300	3
37	Nymph of a tree hopper,	June 5	Lehighton,	100	0	1212	3
38	Crane fly, Tipula sp.,	June 5	Lehighton,	Numerous	0	2438	2
39	Canker worm larva, *Tornos scolopacinarius* Guen,	June 5	Lehighton,	361	0	451	4
40	Ant, *Camponotus herculeanus pennsylvanicus* De Greer var. *ferrugineus* Fabr.	June 12	West Chester,	300	0	300	2
41	Ant, *Camponotus herculeanus pennsylvanicus* De Greer var. *ferrugineus* Fabr.	June 12	West Chester,	0	0	0	0
42	Ant, *Camponotus herculeanus pennsylvanicus* De Greer var. *ferrugineus* Fabr.	June 12	West Chester,	840	0	242	3
43	Beetle, Rhynchites sp.,	June 12	West Chester,	23086	0	1087	5
44	Beetle, *Leptostylus macula* Say,	June 12	West Chester,	0	145340	0	0
45	Beetle, *Helops micans* Fab.,	June 12	West Chester,	9896	6715	247	2
46	Ant, *Formica fusca* L. var. *subsericea* Say,	June 12	West Chester,	0	0	0	0
47	Ant, *Camponotus herculeanus pennsylvanicus* De Greer var. *ferrugineus* Fabr.	June 13	Valley Forge,	547	168	2080	2
48	Aphid, Lachnus,	June 13	Valley Forge,	0	100	0	0
49	Beetle, Cerambycidae,	June 13	Valley Forge,	1566	0	880	1
50	Beetle, *Helops micans* Fab.,	June 13	Valley Forge,	116100	0	982	2
51	Beetle, *Meracantha contracta* Beauv.,	June 13	Valley Forge,	1000	462	692	3
52	Ant, *Camponotus herculeanus pennsylvanicus* De Greer var. *ferrugineus* Fabr.	June 13	Valley Forge,	34200	0	1400	1
53	Aphid, Lachnus sp.,	June 13	Valley Forge,	18263	151	943	4
54	Beetle, *Helops micans* Fab.,	June 13	Valley Forge,	30720	4792	634	3
55	Spider, Phalangium sp.,	June 13	Valley Forge,	2640	0	746	3
56	Beetle, *Arthromacra aenea* Say,	June 13	Valley Forge,	12880	0	2746	4
57	Spider, Phalangium sp.,	June 13	Valley Forge,	390	0	650	6
58	Beetle, *Coccinella novemnotata* Herbst,	June 16	Fairmount Park, Philadelphia,	0	0	180	1
59	Beetle, *Coccinella novemnotata* Herbst,	June 16	Fairmount Park, Philadelphia,	0	0	1561	5
60	Ant, *Formica fusca* L. var. *subsericea* Say,	June 16	Fairmount Park, Philadelphia,	0	0	0	0
61	Ant, *Formica fusca* L. var. *subsericea* Say,	June 16	Fairmount Park, Philadelphia,	0	0	0	0
62	Ant, *Formica fusca* L. var. *subsericea* Say,	June 16	Fairmount Park, Philadelphia,	0	0	0	0
63	Beetle, *Leptostylus macula* Say,	June 19	West Chester,	100	200	409	2
64	Beetle, *Leptostylus macula* Say,	June 19	West Chester,	0	8538	4615	2
65	Beetle, *Leptostylus macula* Say,	June 19	West Chester,	0	100	269	2
66	Beetle, *Leptostylus macula* Say,	June 19	West Chester,	0	1098	446	3
67	Beetle, *Leptostylus macula* Say,	June 19	West Chester,	0	100	394	7
68	Beetle, *Leptostylus macula* Say,	June 19	West Chester,	0	500	200	2
69	Robber fly, Asilus sp.,	June 19	West Chester,	180	0	2400	2
70	Crane fly, Tipula sp.,	June 19	West Chester,	1230	0	357	2
71	Beetle, *Cystela sericea* Forst,	June 19	West Chester,	1680	840	2800	1
72	Ant, *Formica fusca* L. var. *subsericea* Say,	June 19	West Chester,	860	0	1720	2
73	Moth, Micro-lepidopteron,	June 19	West Chester,	1000	0	0	0
74	Beetle, *Arthromacra aenea* Say,	June 19	West Chester,	Present	0	0	0
75	Ant, *Formica fusca* L. var. *subsericea* Say,	June 19	West Chester,	860	300	1433	4

All of the remaining insects were brought to the laboratory from four different points in the field. In all 52 insects were thus brought in, and in addition tests were made of two spiders. Five orders of insects were represented (Table II), and positive results were obtained from insects in all of these except the Lepidoptera, of which only two members were tested. Of the 52 insects from the field 19 were found to be carrying spores of the blight fungus, but both of the spiders yielded negative results. The number of viable spores of *Endothia parasitica* per insect ranged from 74 to 336,960, and five yielded over 4,000 spores each. An abstract of these results has already been published (51).

Reference has been made in the introduction to *Leptostylus macula,* one of the beetles which feeds on pustules of the blight fungus (Figs. 1 and 2). Only eight of these beetles were tested, but all of them yielded positive results. It will be noted that of all the insects tested, the three which yielded the highest numbers of spores of the blight fungus belonged to this species of beetle. A photograph was made of the plate cultures from one of these, insect No. 30, after 6 days of growth, and this is represented in Fig. 3.

On the strength of these results we cannot agree with the conclusions drawn by Craighead (9) and by Anderson and Babcock (2), for the large numbers of spores carried by this beetle certainly indicate that it may be an important agent in the dissemination of the blight fungus.

It has been shown by Anderson and Babcock (see p. 14) that spores will stick to the bodies of ants during their normal movements in a bottle of earth for at least five hours. In our tests most of the insects were brought in from the field in glass tubes. Those from West Chester and Valley Forge were kept in these tubes for at least two hours before they were transferred to flasks of water, and those from Lehighton for a much longer time. The fact that positive results were obtained from many of these bears out the results of the above mentioned writers.

In this connection, however, it might be asked whether the spores might not stick to the feet and body of the insects to such an extent that they would not be brushed off during any

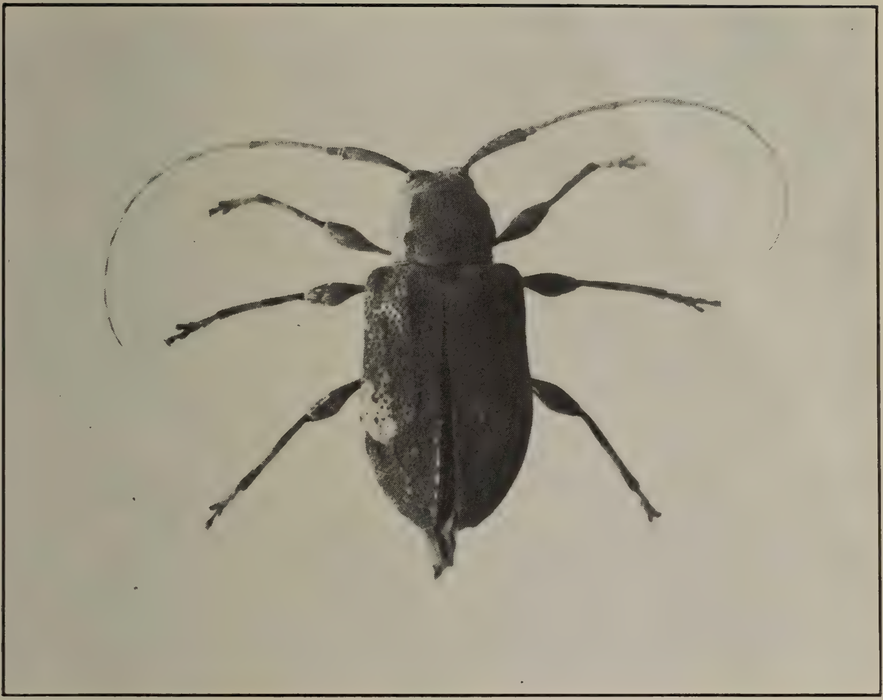


Fig. 1.

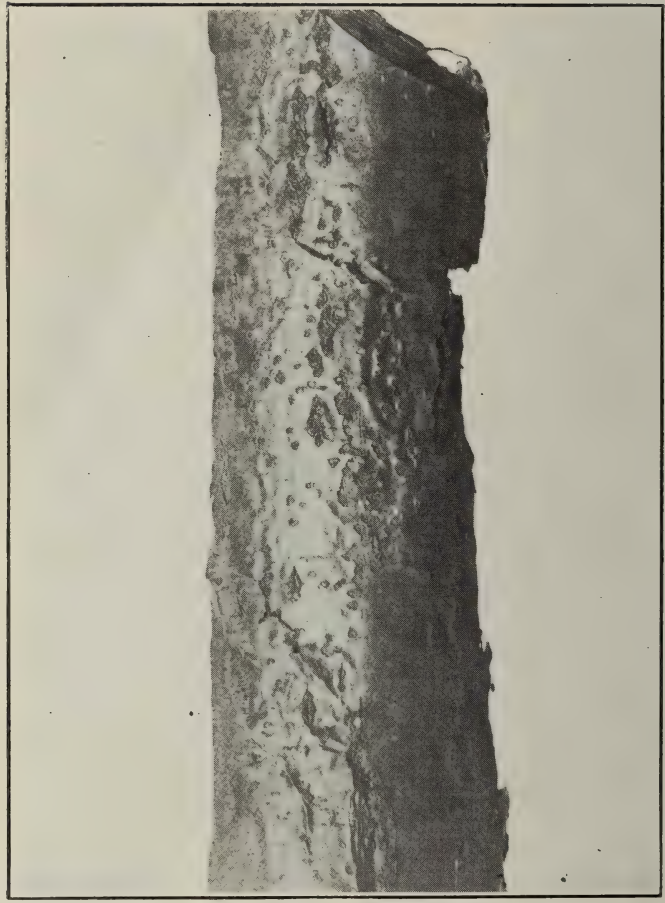


Fig. 2

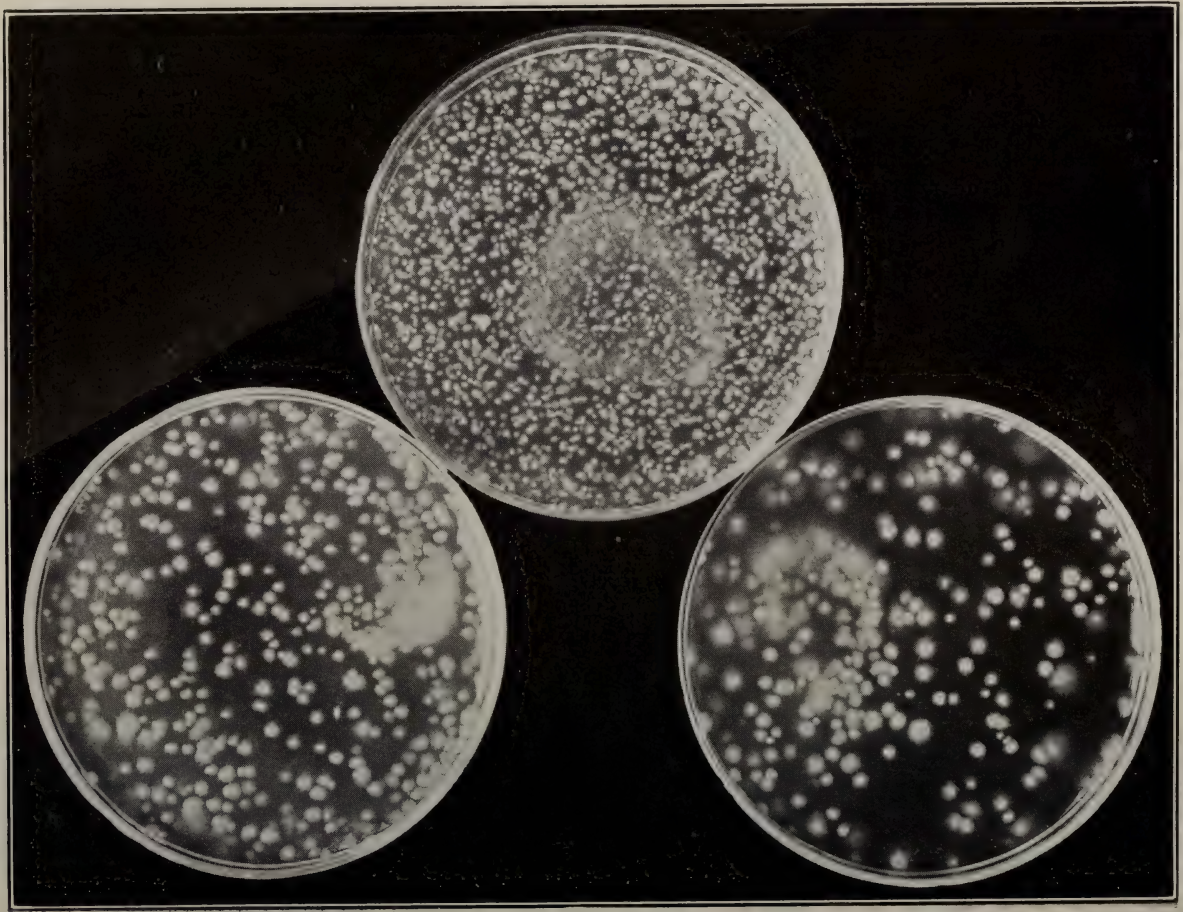
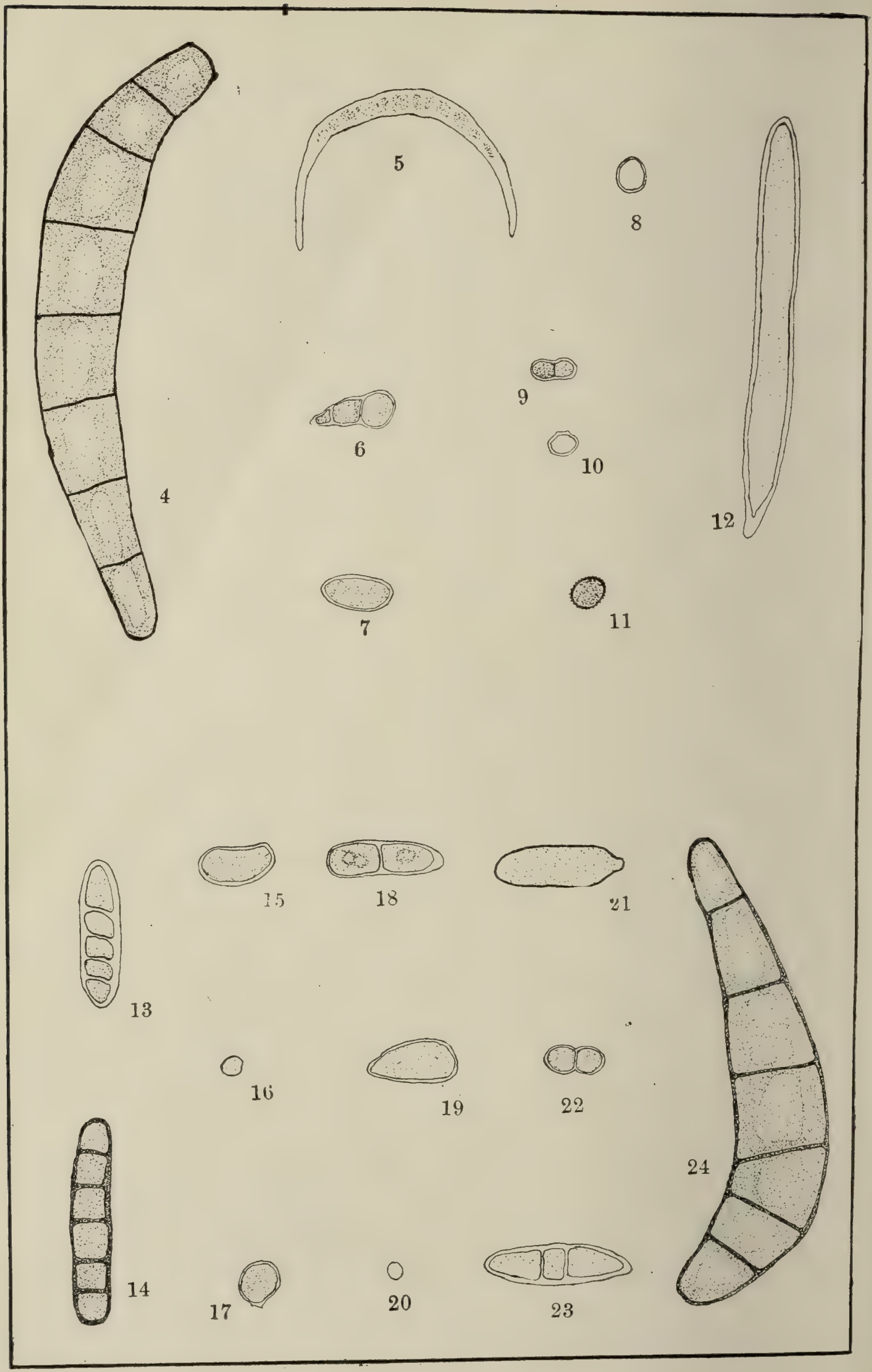


Fig. 3.



Figs 4-24.

normal movements on the part of the insect. In order to get some evidence on this point plate cultures were made from the glass tubes in which insects Nos. 63, 64, and 65 were confined during transit from the field. These three insects were *Leptostylus macula,* taken at West Chester in the afternoon of June 19. After they had been in the glass tubes for about two hours, they were taken out and transferred to flasks of water. On the following day 1 or 2 cc. of sterile water was poured into each tube, which was shaken vigorously, and the water then emptied into a Petri dish and agar poured over it. It will be noticed from the results obtained (Table III) that a fair percentage of the spores originally adhering to the beetles had been shaken from their bodies by their movements within the glass tubes.

The time of development of the colonies of the blight fungus in the cultures indicated that almost all of them originated from pycnospores (17), but a very few of them plainly had their origin from ascospores. The colonies obtained in the plates from insects Nos. 1, 2, 3, and 22, however, started from ascospores, but this is to be expected from the fact that these insects had had access to ascosporic material only.

TABLE II.

SUMMARY OF RESULTS OBTAINED FROM CULTURES.

Kinds of Insects.	Number tested.	Number yielding positive results.	Largest No. of *Endothia parasitica* colonies per single insect.
Hemiptera,	7	3	249
Coleoptera:			
Leptostylus macula,	8	8	336,960
All other beetles,	11	4	6,715
Lepidoptera,	2	0	....
Diptera,	6	1	1,051
Hymenoptera:			
Ants from the field,	18	3	300
Ants from laboratory and insectary,	21	5	4,000
Spiders,	2	0	....
Grand total,	75	24	....
Minus ants from laboratory and insectary,	21	5	....
Total insects and spiders from the field,	54	19	....

TABLE III.

NUMBER OF *Endothia parasitica* SPORES DISLODGED FROM THE FEET AND BODY OF *Leptostylus macula* BY ITS OWN MOVEMENTS.

Insect number.	No. of *Endothia parasitica* spores obtained in the cultures.	No. of *Endothia parasitica* spores obtained from the vials.
63	200	11
64	8,538	85
65	100	3

A comparison of the results from the insects with those from birds tested in a somewhat similar manner(21) shows that the birds carried a larger number of spores of the blight fungus. But it must be remembered that the surface area of the body of the insects is but a small fraction of that of the parts of the birds tested—the head, bill, feet, wing, and tail feathers,—and these latter also offer better opportunities for the lodgment of spores than the smoother bodies of many insects, such as ants. The maximum number of spores of the blight fungus obtained from a single bird was 757,074 not much more than twice the maximum, 336,960, obtained from a single insect. In proportion to size, therefore, insects may carry a much larger number of spores of *Endothia parasitica* than birds. Although the insects probably do not carry the spores to as great distances as birds, especially migratory birds, they can nevertheless carry large enough numbers of spores to be important agents in spreading the blight locally.

In the work on birds as carriers (21) it was found that the highest numbers of spores of the blight fungus were obtained two to four days after a rain, and that the birds were carrying pycnospores only. Not a sufficient number of collections of insects was made to get any definite relation of the number of spores carried to rain periods. It may be stated, however, that nearly all of the insects brought in from the field were taken four days or more after a rain, for May and June, 1913, were rather dry months. Since the insects were carrying pycnospores almost exclusively we believe that they too will be found to carry a larger number of spores of *Endothia parasitica* shortly after rain periods than at other times. It is a noteworthy fact that insects Nos. 63 to 68, all *Leptostylus macula,* and all yielding positive results, were taken at West Chester twelve days after a rain.

The large numbers of spores carried by *L. macula* is no doubt explained by the fact that many spores must necessarily adhere to the body of this beetle while it is eating pustules of the blight fungus. It would be expected that this beetle would carry both pycnospores and ascospores, and such was the case, although the latter were very rare. The other insects also were carrying pycnospores almost exclusively. These pycnospores we believe were obtained for the most part by brushing them off during the normal movements of the insects over diseased and healthy bark, in the same manner in which the birds obtained the pycnospores (21). The reasons for this belief may be summarized as follows:

1. Ascospores are carried away by the wind upon being expelled from the perithecia (2 and 20).
2. Pycnospores are washed down the trunks of trees in great numbers by the rains, even during the winter months, while ascospores are not washed down (18).
3. Viable pycnospores can be obtained in abundance from healthy bark below lesions (51a).
4. We do not believe that the pycnospores were obtained directly from spore horns, because these become hard when dry and spores are not easily brushed from them. This conclusion is substantiated by the fact that only one of the nine insects which had been permitted to run over spore horn material in the insectary yielded positive results.

There is another possible source for some of the pycnospores carried. It is known that pycnospores are washed into the soil around the bases of infected trees, and these have been found to remain viable for a period of two to thirteen days of dry weather (19). It is quite likely that some of the insects, especially the ants, may have obtained considerable numbers of pycnospores from this source.

All told, the insects have very much more opportunity of obtaining pycnospores than ascospores, and it is not surprising that only a very few of the colonies of the chestnut blight fungus developing in the cultures originated from ascospores (17).

MICROSCOPIC EXAMINATION OF CENTRIFUGED SEDIMENTS.

It has already been stated that, beginning with insect No. 34, the original wash water of those insects yielding positive results was centrifuged and given a thorough microscopic examination. The sediment had been concentrated in a very small quantity of water, and the entire sediment was generally examined.

The purpose of the examination was primarily to ascertain whether the spores of *Endothia parasitica* carried were pycnospores or ascospores, this to serve as a check on the observations based on the rapidity of development of the colonies in cultures. It was possible to find pycnospores in the sediment from every insect which had yielded positive results in the cultures. Where these results were high, pycnospores were found very easily, but where the cultures indicated that only a few spores of the blight fungus were carried, they were located with greater difficulty, but could always be found after a reasonable search. The results of these examinations are presented in Table IV. It should be stated that the sediments were free from dirt particles, and that the pycnospores were therefore much easier to find than in the sediments from the birds (21), for a considerable amount of dirt was added to the bird sediments as a result of scrubbing the feet, bill, tail, and wing feathers.

Ascospores were found to be present in the sediments from only five insects, three of which were *Leptostylus macula.* It would seem reasonable to suppose that this insect would carry a considerable number of ascospores on account of its habit of eating the pustules, but such was not the case, for the number of ascospores found in the sediments was only a small fraction of the number of pycnospores present. A probable explanation is that ascospores are not as sticky as pycnospores, and would therefore not adhere so well to the body of the beetle. It is possible that the insects would have carried a larger number of ascospores had they been taken just after a rain, for four of the twelve insects which had run over active perithecia in the laboratory and insectary yielded positive results. This possibility, however, will appear less likely when we reason by analogy with the results obtained from the birds (21), for not a single ascospore was found in the sediments from the 19 birds yielding positive results, although many of them had been shot just after rains.

TABLE IV.

RESULTS OF MICROSCOPIC EXAMINATION OF CENTRIFUGED SEDIMENTS.

Insect numbers.	No. of spores of blight fungus carried as shown by cultures.	Kind of spores as shown by microscopic examination of sediments.
1-33	....	Sediment not retained.
34-35	0	Examination not necessary.
36	249	Pycnospores present; no ascospores.
44	145,340	*Pycnospores very abundant; 9 ascospores.*
45	6,715	*Pycnospores abundant; 3 ascospores*
46	0	Examination not necessary.
47	168	Pycnospores present; no ascospores.
48	100	Pycnospores present; no ascospores.
49-50	0	Examination not necessary.
51	462	Pycnospores present; no ascospores.
52	0	Examination not necessary.
53	151	Pycnospores present; no ascospores.
54	4,792	Pycnospores easily found; no ascospores.
55-62	0	Examination not necessary.
63	200	Pycnospores present; no ascospores.
64	8,538	*Pycnospores abundant; 2 ascospores.*
65	100	Pycnospores present; no ascospores.
66	1,098	Pycnospores present; no ascospores.
67	100	Pycnospores present; no ascospores.
68	500	Pycnospores present; 1 *ascospore*
69-70	0	Examination not necessary.
71	840	Pycnospores present; 2 *ascospores.*
72-74	0	Examination not necessary.
75	300	Pycnospores present; no ascospores.

SPORES OF OTHER FUNGI CARRIED BY THE INSECTS.

The results obtained in the cultures show that 10 of the 19 insects brought in from the field and yielding positive results carried a larger number of spores of the blight fungus than of all other fungi combined, and three of these (Nos. 22, 44, and 48) were not carrying any other fungous spores. In addition, insect No. 30, which yielded the highest positive results obtained (Fig. 3), gave almost pure cultures of the chestnut blight fungus.

The number of species of fungi other than *Endothia parasitica* represented in the cultures varied from 0 to 7 per insect, and those which appeared most frequently were species of Penicillium and Cladosporium. Little attempt was made to identify those species less frequently met with, especially if they did not fruit in culture.

As was the case in the work on the birds, the microscopic examination of the centrifuged sediments revealed the fact that a larger number of species of fungi was carried by at least some insects than was indicated in the cultures. The determination of the number of species carried was based upon the cultures and on the microscopic examination of the centrifuged sediments. In the latter the size, form, septation, and coloration of the spores were taken into consideration. One form in particular was frequently found in the sediments, which never appeared in the cultures, probably on account of its slow growth. This was a species of Coryneum. It is our opinion that the number of fungous spores carried was very likely greater in every case than was shown by the cultures (Table I).

The fungous spores, other than those of the blight fungus, found in the sediment from insects Nos. 44 and 64 are represented in Figs. 4-24. In the sediment from the latter insect, 10 different kinds of spores were found, while only 2 species of fungi other than the blight fungus appeared in the cultures. In the former the numbers were 7 and 0 respectively.

SUMMARY AND CONCLUSIONS.

1. Each insect tested was placed in a flask containing 100 cc. of sterile water, kept there for at least several hours, small quantities of the water plated out in dilution plates, and the wash water centrifuged in case positive results were obtained.

2. Tests were made of 21 ants used in certain laboratory and insectary experiments in which they had been permitted to run over chestnut bark bearing spore horns or active perithecial pustules of the chestnut blight fungus, *Endothia parasitica.*

3. Five of these 21 ants were found to be carrying spores of the chestnut blight fungus.

4. Tests were also made of 52 insects and 2 spiders brought in from the field. All but three of these were picked directly from the chestnut blight cankers.

5. Both of the spiders yielded negative results, while 19 of the 52 insects from the field were found to be carrying spores of *Endothia parasitica.*

6. Positive results were obtained from insects in the orders Hemiptera, Coleoptera, Diptera, and Hymenoptera. The only other order of insects represented was the Lepidoptera, of which only two individuals were tested, both with negative results.

7. The number of viable spores of the blight fungus carried varied from 74 to 336,960 per insect.

8. The cultures from three insects contained no fungous colonies except those of *Endothia parasitica.*

9. Each of the eight individuals tested of *Leptostylus macula,* one of the beetles which feeds on pustules of the blight fungus, yielded positive results.

10. The three highest positive results obtained, 336,960, 145,340 and 8,538, were from *Leptostylus macula.*

11. It was demonstrated that the spores of the blight fungus were easily shaken from the body of this beetle by its own movements.

12. From the rate of development of the colonies of *Endothia parasitica* in cultures, it was determined that the insects from the field were carrying pycnospores almost exclusively.

13. A microscopic examination of the centrifuged sediments showed a very few ascospores, and these from only five insects. Pycnospores were present in the sediment from every insect yielding positive results.

14. The insects tested, even *Leptostylus macula,* which eats the pustules, were therefore carrying pycnospores almost exclusively.

15. Most of the pycnospores were probably brushed off from normal or diseased bark, or both, by the movements of the insects over these surfaces. Some were probably obtained while eating the pustules, and some may have been obtained from the soil around the bases of diseased trees.

16. Most of the insects were also carrying spores of fungi other than *Endothia parasitica.* The number of species of other fungi varied from 0 to 7 in the cultures, but was shown by microscopic examination of the centrifuged sediments to be greater in at least some cases.

17. In proportion to size, insects may carry a greater number of spores of the blight fungus than birds.

18. We are led to the conclusion that some insects carry a large number of spores of the blight fungus, and that they are important agents in the local dissemination of this disease. This is especially true of the beetle, *Leptostylus macula.*

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EXPLANATION OF PLATES.

PLATE I.

Fig. 1. *Leptostylus macula* Say, one of the beetles which feeds on pustules of the chestnut blight fungus.

Fig. 2. Piece of chestnut bark showing pustules of the chestnut blight fungus eaten out by *Leptostylus macula.*

PLATE II.

Fig. 3. Series of cultures 6 days old obtained in the test of insect No. 30, *Leptostylus macula.* The upper Petri dish contained 1-100 of the water in which the insect was washed; the plate at the lower left contained 1-480; and the one at the lower right, 1-960. The last mentioned plate contained only one fungous colony other than *Endothia parasitica;* the other two represented pure cultures of the chestnut blight fungus.

PLATE III.

Figs. 4-12. Spores of fungi other than *Endothia parasitica* found in the centrifuged sediment from insect No. 44, *Leptostylus macula.*

Fig. 4, dark brown; Fig. 5, hyaline; Fig. 6, light brown; Fig. 7, light brown, Fig. 8, hyaline; Fig. 9, dark brown; Fig. 10, hyaline; Fig. 11, dark brown; Fig. 12, pale smoky.

Figs. 13-24. Spores of fungi other than *Endothia parasitica* found in the centrifuged sediment from insect No. 64, *Leptostylus macula.*

Fig. 13, light brown; Fig. 14, dark brown; Fig. 15, dark brown; Fig. 16, hyaline; Fig. 17, dark smoky; Fig. 18, dark smoky; Fig. 19, light brown; Fig. 20, hyaline; Fig. 21, light smoky; Fig. 22, light brown; Fig. 23, light smoky; Fig. 24, dark brown.

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